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CIVIL SERVICE EXAMINATIONS for positions under the United States Government will be held as follows: Nov. 14, nautical expert, Navy Department, Hydrographic Office; Nov. 14 and 15, inspector of heating and ventilating apparatus in connection with public buildings, Supervising Architect's Office, Treasury Department; Dec. 5, 6, 7, 8, ship draftsman and assistant ship draftsman, Bureau of Construction and Repair, Navy Department. The examinations may be taken at any place in the United States where the Civil Service Commission has a Board of Examiners, and are open to all citizens who comply with the requirements. Application blanks can be had from the Civil Service Commission at Washington, D. C.

A CIVIL SERVICE COMMISSION EXAMINER is desired by the New York State Civil Service Commission, and an examination for applicants will be held in various cities throughout the state on Nov. 4. The duties of the position require the whole time of the incumbent, who must be able to prepare and rate examinations for mechanical and electrical positions such as steam engineer, fireman, electrician, as well as to assist in preparing and conducting general examinations. Considerable clerical work is required. The salary is $1,200 to $1,400 per year. The subjects upon which the applicants for this position will be examined and their relative weights in the rating of the applicants are as follows: Experience and education, 5; preparing questions and marking examination papers, 7; mathematics, arithmetic, algebra including logarithms, and plain geometry, 4; discussion on a subject relating to civil service examinations, 4. Intending competitors must file applications in the office of the State Civil Service Commission, Albany, N. Y., on or before Oct. 30. No one will be admitted to examination without official notice from the Chief Examiner of the Commission. Applicants must be at least 21 years of age, and must be citizens and residents of New York state. The time allowed for the examination will be six hours.

MUNICIPAL OWNERSHIP OF WATER-WORKS AT Denver, Colo., is to be voted on at the election on Nov. 7. The proposition is to issue $4,700,000 of 4% bonds to buy or build works.

A BILL AUTHORIZING ANY WATER CONSUMER TO buy water by meter instead of fixture rates was indefinitely postponed by the common council of Philadelphia, the other day, after having been unanimously passed by the select council. It was urged in favor of the bill that it had no compulsory features and would reduce the enormous waste now in vogue, but the bill was killed by a viva voce vote.

SUITS TO SECURE PAYMENT FOR WATER used in sewerage flush tanks have been filed by the Racine Water Co. against the city of Racine, Wis., and by the Brunswick Light & Water Co., against Brunswick, Ga. Each city claims that under the respective contracts water for this service should be furnished without extra charge. The Racine Water Co., in particular, has urged for several years that an enormous waste of water was occasioned by the tanks. It now sues for $18,611, for 310,274,000 gallons of water used during the year ending Nov. 1, 1898. At Brunswick, the period covered runs from Jan. 1, 1895, to Oct. 1, 1899, during which time the company claims 49,932,000 gallons were supplied to the tanks and 18,199,000 gallons to street sprinkling carts. The price demanded is at the rate of 10 cts. a gallon, and amounts to $6,813, less $1,434, for one year's free service. The Brunswick case was brought in the United States Court, at Savannah.

A 50,000-GALLON ELEVATED WATER TANK, at Ocean City, N. J., fell on Oct. 18, damaging the pumping and power station of the light and water company. The tank was some 50 to 75 ft. above the ground. Mr. H. M. Kalbach is Superintendent of the Ocean City Water Co.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by a break in two on the Wabash R. R., near Wabash, Ind., on Oct. 23. The break in two occurred on a freight train, which was climbing a grade, and the wild cars ran back down the grade and collided with another freight train, completely wrecking the engine and killing two men.

RAPID TRACK REMOVAL is sometimes accomplished as well as rapid tracklaying. The Flint & Pere Marquette R. R. recently had ten miles of rail to take up on a forest road, upon which they had done but little business during the past year,and to avoid some legal complications they decided a few days before Oct.15 to take it up on that date. No preliminary arrangements could be made, so they had to take the track as it was, with the spike, nuts, etc., all in place, and the ties covered with sand and rubbish in many cuts and at log roll-ways. A force of 230 men was picked up and got upon the ground about midnight; but on account of heavy rain and delay in getting up the siding, only one mile of track was taken up before daylight. Then the engine had to run 10 miles for water, returning at 8:20 a. m. In eight hours after 8:20 a. m., one gang of men loaded 6½ miles of 56-lb. rail and two side tracks over the rear end of a train of flats, or 7½ miles altogether. The only machinery used was rollers hastily prepared which were placed on cars and on a skid at the end of the train. It is believed that this piece of work beats the record in time occupied for such work.

THE KALKA-SIMLA RAILWAY PROJECT, in India, to connect the terminus of the standard-gage line at Kalka with the hill capital of Simla, is described in the "Indian Engineer." The line would be 59 miles long, as compared with a cart-road 57⅛ miles long. The ruling grade would be 3%, with curves not exceeding a radius of 150 ft. The predominant feature is an abnormal development along the base of Kasouli Hill. The road rises from an elevation of 139 ft. above sea level to 7,058 ft. at Simla, and the estimated cost is $2,888,835.

THE WAGNER-PULLMAN PALACE CAR COMBINATION is completed. Under the arrangement made, the stockholders of the Wagner Palace Car Co. receive either $180 per share, or share for share in the stock of the Pullman Palace-Car Co., as they may elect. For this purpose the Pullman company is to increase its capital by 200,000 shares of stock. The Wagner company will be dissolved. There are also rumors of an exchange of Boston & Albany stock, held by the Pullman company, which would give the Vanderbilt interests an entrance to Boston. The Pullman Palace Car Co. was organized Feb. 22, 1867, to manufacture cars of all kinds, and to operate a service of sleeping and parlor cars. The company owns and controls about 500 cars operated over 121,662 miles of railway in the United States, Canada, Mexico, and, to some extent,in Europe. In October, 1898, the capital stock was increased from $36,000,000 to $54,000,000, the additional stock being delivered to stockholders as an extra dividend, though it had paid 8% for more than 25 years. The Wagner company was capitalized at $20,000,000, and operates its cars over 16,000 miles of railways in twenty states, and also paid 8% dividends.

THE RAISING OF THE UNION STATION at Omaha, Neb., has been rendered necessary by the settlement of the foundations. It is built partly on made ground in a ravine, the soil being clay, and it is supposed that the soil was not sufficiently tested or that the foundations were not given sufficient proportions. The amount of settlement was from 4¾ to 9 ins. The building was raised from the foundation walls by jackscrews, and the foundations were then strengthened by concrete reinforcing walls and steel beams. This work was done by H. Sheeler, 115 Dearborn St., Chicago, Ill. The station was built in 1898-99, and was described and illustrated in our issue of June 1, 1899.

INTEROCEAN RAILWAYS, as effected by transcontinental railways, are discussed in the "National Geographic Magazine." The Panama Railway is 47⅓ miles long, cost $8,000,000, and was opened to traffic on Jan. 28, 1855. It was the principal avenue of traffic between the Atlantic and Pacific Coasts of the United States until the completion of the Union and Central Pacific railways on May 10, 1869. In 1869 the total value of merchandise passing between New York and San Francisco, via Panama, was $70,202,029; in the following year this value fell to $18,594,255 as a result of transcontinental railway competition; and in the year ending June 30, 1898, this Panama trade amounted to only $4,887,289. In 1897 the trade via Panama to the west coast of North and South and Central America amounted to only 200,651 tons, while the nine transcontinental railways carried over 3,000,000 tons.

A JAMAICA-ENGLAND STEAMSHIP LINE has been established by the Jamaica Fruit & Produce Association, says the "British Trade Journal." The contract of this company with the Colonial Office is for five years and the steamers are to be run fortnightly between Kingston and San Antonio and Southampton. The steamers will have an average speed of 15 knots, and will be fitted for carrying fruit, and each will store at least 20,000 bunches of bananas. The subsidy payable is £10,000 per annum—one-half being contributed by the Imperial Government. The purpose of the new arrangement is to promote English trade and to meet possible conventions made between the United States and English colonies in the West Indies. Out of a total of imports and exports of the British West Indies, amounting to $28,554,700 of imports into, and $24,790,728 of exports to these colonies in 1897, the United States controlled 27.94% of the imports and 50.74% of the exports.

THE U. S. CRUISER "NEW ORLEANS," built by the Armstrongs in England, and bought from the Brazilian government prior to the Spanish-American War,proved to be a heavy roller at sea, and stability tests made at the Brooklyn Navy Yard confirm the reports of her officers. With a weight of 32,650 lbs. placed on her starboard side, she listed about 8 ins., and rolled heavily, when the two weights were placed and removed. On her way from Hampton Roads to New York, she is said to have rolled 28° one way and 23° the other. The officers charge much of this to her steel masts and heavily-armored fighting-tops; and they think she could afford to do without these. The "New Orleans" displaces 3,900 tons, has 7,500 IHP. and can make 17 knots under forced draft. Later information says that as these tests were made without full load the ship is not quite so bad as the experiments would tend to prove. In any event the "New Orleans" has sailed for Manila, via Suez.

THE TURBINE-ENGINED TORPEDO-BOAT DESTROYERS, now being built in England, with machinery similar to the little "Turbinia," of Mr. C. A. Parsons, are described in Brassey's "Naval Annual." The length between perpendiculars is 210 ft., extreme beam 21 ft., and the molded depth is 12 ft. 9 ins. With a draft of 5 ft. 4 ins., the displacement is 320 tons. There are four propeller shafts each fitted with two screws and operated by two separate sets of engines. On each side of the vessel is a high-pressure turbine motor, driving the outer screw shaft; and on each inner screw shaft is one low-pressure motor and one small reversing turbine motor, the inner screws being used for going astern. The total power is 10,000 I. HP., which it is calculated will give a speed of 35 knots, with 16 knots going astern. On each side is a surface condenser, with two air-pumps driven by turbines; but the two circulating pumps are operated by ordinary double-acting engines. The boiler room weights, with water in boilers, is 100 tons 15 cwt.; engine-room, with auxiliary gear and water in condensers, 52 tons 6 cwt.; propellers, shafting, etc., 7 tons 14 cwt. Consequently, with 12,000 HP. developed, the weight of machinery is about 30 lbs. per I. HP. In a 30-knot torpedo-boat destroyer of ordinary design and similar size, the corresponding machinery weights are, 78 tons, 56 tons and 10 tons; or, with 6,000 HP. developed, about 53¾ lbs. per I. HP. In the turbine engines the lowered center of gravity is also an advantage, and the machinery can be driven to the highest speed without danger.

THE TORPEDO BOAT "DAHLGREN," on her official speed test on Oct. 23, obtained a mean speed of 30 knots with 317 revolutions. The trial was a progressive one over the measured mile in Booth Bay harbor. The mean speed of the first double run was 22 knots, with an average of 238 revolutions of the screws; for the next double run the mean was 24.5 knots, with 264 revolutions; the third run showed 26¼ knots, with 283 revolutions, and the fourth gave the speed above recorded. The "Dahlgren" was built by the Bath Iron Works, and she is 152 ft. long; extreme beam, 17 ft.; depth at center amidships, 10 ft.; mean draft, 4 ft. 9 ins., and draft under propellers, 8 ft. 9 ins. The steel hull is said to be the lightest ever constructed for this type of boat, and she is fitted with two triple expansion engines, 17 by 25 ins., and 37 by 21 ins., driving twin screws. There are two Normand water tube boilers working at 230 lbs. pressure. The estimated power is 4,200 HP., and the total weight of the machinery is only 80 tons.

THE LARGEST LOCOMOTIVE IN THE WORLD; ILLINOIS CENTRAL R. R.

(With two-page plate.)

The Illinois Central R. R. is one of the latest railways to join in the general movement towards increasing the weight of freight trains and introducing specially heavy engines for this work. Last spring, orders were given to the Brooks Locomotive Works, of Dunkirk, N. Y., and the Rogers Locomotive Works, of Paterson, N. J., for one engine each, to haul train loads of 2,000 tons on the division between Carbondale, Ill., and Fulton, Ky., which has grades of 0.76%, and 5° curves. The design was left to the builders. The Brooks engine is of the twelve-wheel type, and is about 2,000 lbs. heavier than the heaviest engine yet built, though in weight upon the drivers it ranks fourth among the monster engines which we have on record. This may be seen by reference to the list of large consolidation engines, given in our issue of July 27, 1899. The accompanying table shows the comparative dimensions and weights of the two new engines for the Illinois Central R. R., and of some other heavy locomotives:

All the driving wheels are flanged, having tires 5½ ins. wide over all. The main driving axle (which is the second), is hollow, with bearings 9½ × 16 ins., and having a 5½-in. hole. The other driving axles have bearings 9 × 12 ins., while the truck axles have bearings 5½ × 12 ins. The main crank pin has a bearing 7½ × 7 ins. for the connecting rod, and another 8¼ × 5 ins. for the coupling rod. The coupling pins in the third pair of driving wheels are 5½ × 5 ins., those in the first and fourth pairs are 4½ × 4½ ins. The wheel gage, or distance back to back of flanges, is 53¼ ins. for the front and rear pairs, and 53½ ins. for the two middle pairs; for the truck wheels, it is 53⅜ ins. The driving springs consist of four inverted semi-elliptic plate springs on each side, connected by links to the ends of rockers resting on the boxes. The spring plates are 7-16 × 6 ins. The front driving axle, however, is independent of this equalizing arrangement, but has a transverse spring whose ends rest on the boxes, while the center takes a bearing under one of the transverse members between the frames.

The piston rods are 4½ ins. diameter, and extend through the front cylinder heads, being enclosed in steel tubing, and are fitted with the Jerome packing. The valve stems are also extended through the front heads of the valve chests. The crossheads are hollow steel castings, with flanged slippers on the guide bars. The upper bars are 3 × 8 ins., and the lower bars 2⅞ × 7½ ins.

The valve gear is of the Stephenson link type, with eccentrics on the main driving axle, giving but a short length for the eccentric rods. A coiled steel spring prevents any shock on the reversing shaft. The Brooks piston valve is used, as in many large engines built by this firm, and details of the valve were given in our issue of April 14, 1898. The valves are 12 ins. diameter, with a maximum travel of 7 ins., and are placed in the saddle above and inside the cylinders. The connecting rods are of I-section. The coupling rods are of rectangular section, fishbellied in shape, with strap ends.

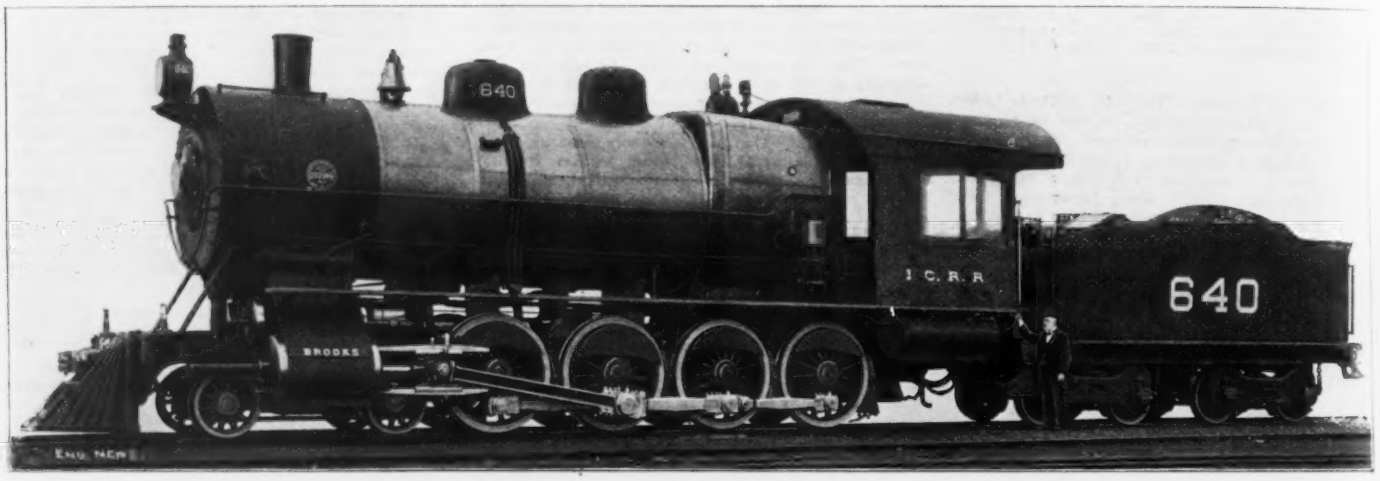
The huge boiler is 6 ft. 10 ins. diameter at the smallest barrel course, and 7 ft. 1 in. diameter over the jacket. Its center line is 9 ft. 8 ins. above the rails, and the length between tube plates is 14 ft. 7 ins. The firebox is of the Belpaire type, 6 ft. 4 ins. wide at the widest part, and having a slightly cambered crown sheet, with vertical crown stays, while horizontal stays connect the flat sides of the shell. An unusually large grate area is provided, but the Rogers consolidation engine, which is to work in competition with this engine, has a little more grate area, though with less heating surface. In the twelve-wheel engine there are 93.33 sq. ft. of heating surface to each square foot of grate surface. The firing hole is 14×17 ins., fitted with a sliding door made in halves which are operated simultaneously by a lever.

A stumpy smokestack is set on the back end of the smokebox. The spark-arresting device is on Mr. J. Snowden Bell's system, having a perforated deflecting plate extending from above the top row of tubes to the front side of the exhaust pipe. Wire netting, with a mesh of 2½ × 2½ ins., and 2½ × 2¼ ins., extends upward from the top of the nozzle. An aperture is left in the netting, however, to allow the passage of large cinders, the bell arrangement being for what is termed a self-cleaning smokebox, with a short extension front. It is intended to eject all sparks and cinders, instead of using the smokebox as a receptacle for cinders. This self-cleaning arrangement, however, was not received with favor in the discussion of Mr. Bell's paper on "Locomotive Front Ends," which was presented at the September meeting of the Western Railway Club.

The headlight is not set on top of the smokebox, but on a shelf in front. On the flat top of the boiler, over the firebox, is the fitting for the whistle and the Ashton safety valves. The low dome, 30 × 18 ins., is on the wagon top or throat sheet, while the bell and sandbox are on the cylindrical barrel. The sand is fed by an air jet, and is piped to the forward side of the first and third pair of driving wheels, and to the back of the rear pair.

The brake equipment includes the Westinghouse automatic brake for engine, tender and train, with the American outside equalized driving-wheel brake. A 9½-in. air pump is used, and the main air reservoir, 26½ × 64 ins., is placed under the fireman's side of the cab. The brake cylinder is 14 × 12 ins., placed under the boiler, close to the cylinder saddle.

The tender is one of the largest and heaviest ever built, if indeed it does not hold the record. Its loaded weight is 132,700 lbs., but the weight empty is only about 47,500 lbs. This is by no means disproportionate, but rather economical, as compared with other tenders, when it is considered that the tender carries no less than 7,000 gallons of water and 12 tons of coal. The tender has an oak frame, 24 ft. long over the sills, and is mounted on a pair of pressed steel trucks, with coiled springs over the boxes, and double elliptic springs under the ends of the bolsters. The tank is of horseshoe shape and is built of ¼-in. steel plates.



TWELVE-WHEEL FREIGHT LOCOMOTIVE; ILLINOIS CENTRAL R. R.
Brooks Locomotive Works, Builders.

Table of Dimensions of Heavy Locomotives.

Railway	Illinois Central.	Illinois Central.	Union.	Great Northern.	Southern Pacific.	Northern Pacific.	C., C., C. & St. L.	Buf., R. & Pitts.
Type	12-wheel.	Consolidation.	Consolidation.	12-wheel.	12-wheel.	12-wheel.	Consolidation.	12-wheel.
Builder	Brooks.	Rogers.	Pittsburg.	Brooks.	Schenectady.	Schenectady.	Richmond.	Brooks.
Driving wheels	4 ft. 9 ins.	4 ft. 9 ins.	4 ft. 6 ins.	4 ft. 7 ins.	4 ft. 7 ins.	4 ft. 7 ins.	4 ft. 8 ins.	4 ft. 7 ins.
Wheelbase, driving	15 " 9 "	16 " 3 "	15 " 7 "	15 " 10 "	15 " 6 "	15 " 6 "	16 " 3 "	15 " 6 "
Total	26 " 6 "	24 " 5 "	24 " 0 "	26 " 8 "	26 " 5 "	26 " 4 "	24 " 2 "	25 " 5 "
Weight on drivers	193,200 lbs.	194,000 lbs.	208,000 lbs.	172,000 lbs.	155,000 lbs.	150,000 lbs.	162,000 lbs.	148,000 lbs.
Total	232,200 "	214,000 "	230,000 "	212,750 "	192,000 "	186,000 "	180,000 "	175,000 "
Engine & tender	364,900 "	.....	334,000 "	308,750 "	291,535 "	270,620 "	300,000 "	265,000 "
Comp'nd or simple	Simple.	Simple.	Simple.	Simple.	2-cyldr. compd.	2-cyldr. compd.	Simple.	Simple.
Cylinders	23 × 30 ins.	23 × 30 ins.	23 × 32 ins.	21 × 34 ins.	23 and 35 × 32 ins.	23 and 34 × 30 ins.	22 × 30 ins.	21 × 26 ins.
Boiler, diameter	6 ft. 8 ins.	6 ft. 6 ins.	6 ft. 8 ins.	6 ft. 6 ins.	6 ft.	6 ft.	6 ft.	5 ft. 6¾ ins.
Pressure	210 lbs.	210 lbs.	200 lbs.	210 lbs.	200 lbs.	200 lbs.	200 lbs.	180 lbs.
Firebox	11 ft. × 3 ft. 6 ins.	11 ft. × 3 ft. 6 ins.	10 ft. × 3 ft. 4 ins.	10′ 4″ × 3′ 4½″	10 ft. × 3 ft. 6 ins.	10 ft. × 3 ft. 6 ins.	9′ 11″ × 3′ 5″	9½ ft.×3 ft.2¼ ins.
Tubes, No.	424	417	355	376	332	332	376	324
Diameter	2 ins.	2 ins.	2¼ ins.	2¼ ins.	2¼ ins.	2¼ ins.	2 ins.	2 ins.
Length	14 ft. 8⅝ ins.	13 ft.	15 ft.	13 ft. 10⅝ ins.	14 ft. 6 ins.	14 ft.	13 ft. 5 ins.	12 ft. 7 9/16 ins.
Heating surf., tubes	3,237 sq. ft.	2,951 sq. ft.	3,117 sq. ft.	3,043 sq. ft.	2,819.34 sq. ft.	2,721.60 sq. ft.	2,623.00 sq. ft.	2,106.0 sq. ft.
Total	3,500 "	3,203 "	3,322 "	3,280 "	3,025.85 "	2,943.41 "	2,800.00 "	2,331.0 "
Grate area	37½ "	38½ "	33½ "	34 "	35.00 "	35.00 "	33.88 "	30.4 "
Water in tank	7,000 gallons.	5,000 gallons.	.....	4,670 gallons.	4,500 gallons.	4,000 gallons.	6,000 gallons.	4,500 gallons.
Coal on tender	28,800 lbs.	.....	.....	22,400 lbs.	22,400 lbs.	15,000 lbs.	22,400 lbs.	18,000 lbs.
Date in Eng. News	Present issue.	Aug. 14, 1899.	Oct. 27, 1898.	April 14, 1898.	.....	Feb. 25, 1897.	.....	Jan. 21, 1897.

it is 22 ft. long, 10 ft. wide, and 6 ft. high (exclusive of the collar). The Thurmond M. C. B. coupler is fitted to the tender and the engine pilot.

The total length, over all, is 42 ft. 0⅝ in. for the engine alone, and 65 ft. 7⅝ ins. for the engine and tender. The width is 9 ft. 1 in. over the running boards, and 10 ft. 4 ins. over the cab. The engine and tender together represent a weight of 183 tons.

The general dimensions of this enormous and notable engine are given below, in our standard form:

Dimensions of 12-Wheel Freight Locomotive; Illinois Central R. R.

Running Gear:	
Driving wh'ls (8), 4 ft. 9 ins.; Truck wh'ls (4),	2 ft. 6 ins.
Tender wheels (8)	2 " 9 "
Driving wheel centers	Cast steel.
How are driving-wheels tires secured?	By shrinkage.
Engine truck	Swing center.
Journals, driv. axle, 9½×12 ins.; Coupled axles	9×12 ins.
Wheelbase: Driving, 15 ft. 9 ins; truck,	6 ft. 6 "
Total engine	26 " 6 "
Engine and tender	55 " 2¾"
Engine truck-pin to c. of leading driving wh'l	7 " 6 "
Wheels having blind tires	None.
Weight in Working Order:	
On driving wheels	193,200 lbs.
On truck wheels	39,000 "
Engine, total	232,200 "
Tender, loaded	132,700 "
Cylinders: Number	Two.
Diameter and stroke	23 × 30 ins.
Crosshead and guides.	Alligator crosshead, 2-bar guides.
Connecting-rod, length between centers	8 ft. 2 ins.
Side rod	Strap ends.
Valve Gear: Type	Stephenson link.
Ports steam	28 × 2½ ins.
Ports, exhaust (minimum area)	110 sq. ins.
Bridges, width	3½ "
Slide valves, style, Piston; maximum travel	7 "
" inside lap, 1⅛ ins.; outside lap,	None.
" lead in full gear (variable), negative	1/16-in.
Boiler: Type	Player-Belpaire wagon-top.
Barrel, diameter inside smallest ring	6 ft. 8⅝ ins.
Dome, diameter	2 " 6 "
Thickness, barrel plates	-.25/32-in. and 1 in.
" smokebox tube-plate	¾-in.
Horizontal seams	Sextuple riveted.
Circumferential seams	Triple riveted.
Joints	Lap.
Height from rail to center line	9 ft. 8 ins.
Length of smokebox, including extension	6 " 3 "
Spark arresting device	Bell's, with netting.
Injectors (2),	Hancock.
Working steam pressure	210 lbs.
Firebox: Type	Belpaire, long; above frames.
Length inside	11 ft.; width inside 3 ft. 6 ins.
Depth at front	7 ft. 6 ins.; depth at back 6 " 9½"
Thickness, side plates	⅜-in.; back plate ⅜-in.
" cr'n plate	7/16-in.; tube plate ⅝-in.
Crown stays	Vertical.
Grate bars	Cast-iron rocking.
Is firebrick arch used?	Yes; on studs.
Water spaces (width at top), front	4 ins.
" " back	5 "
" " sides	7½"
Mud ring (width), front and back, 4 ins.; sides	3½"
Tubes, charcoal iron; No.	424
Thickness No. 12 B.W.G.; pitch	3/16 ins.
Diameter, outside	2 "
Length over tube plates	14 ft. 8¾ "
Heating Surface and Grate Area:	
Heating surface, tubes (interior area)	3,237.0 sq. ft.
" firebox	263.0 "
" total	3,500.0 "
Grate area	37.5 "
Ratio of total heating surf. to grate area	93.33 to 1
Miscellaneous:	
Exhaust nozzle (single), diameter	5⅞ and 6⅛ ins.
Distance below center line of boiler	7 "
Smokestack, diam. at top, 17¾ ins.; at base	15¼"
" height above smokebox	2 ft. 2⅛"
" height of top above rail	15 " 5 "
Capacity of tender tank	7,000 galls.
Capacity of coal space	12 tons.
Brake fittings	Westinghouse-American.

SOME UNRECOGNIZED FUNCTIONS OF STATE UNIVERSITIES.*

Introduction.

The question I shall propound, and attempt partially to answer, is: What functions in the department of technical science should our state universities be called upon to exercise, in addition to those which they now commonly perform?

In the College of Mechanics and Engineering in the University of Wisconsin, to which recently I have been called as Dean, and which may be taken as a fair example of such departments in other American state universities, very complete courses are maintained in Civil, Sanitary, Mechanical, Electrical, and Electro-Chemical Engineering, and we hope ere long to add a course in Architecture.

In our state agricultural colleges, also, various courses of study are well adapted to promote in every way the highest forms of scientific agriculture. These schools of engineering and agriculture have already served to place our country in the front rank in all lines of civil, mechanical and electrical engineering, and in many lines of agricultural practice, and our success in these fields is a promise and guaranty of what could be accomplished in other departments of industrial and commercial life which are now suffering for want of such scientific direction.

Turning now to the subject proper of this address, I will name a few of the most crying demands which, in my opinion, the citizens who support our state universities have a right to call upon the departments of applied science to meet and satisfy.

I.—The Education of Teachers of Sanitary Science.

The wonderful revolution wrought by the recent studies in bacteriology in explaining the nature, the spread, and the prevention of disease, has made it incumbent upon all our educational agencies to provide instruction in these most important matters. We should now have a competent teacher of sanitary science in every high-school, and eventually some such instruction should be given in every primary school. No subject yields more readily to school instruction than this, and the interest which could be aroused by a competent teacher in this department would be a revelation to the old-time pedagogue. As the greatest things in this world are life and health, so this revelation of the numerous ways in which health is impaired and lives are lost, and of the means of preventing these fatal maladies, should and would prove of the greatest possible interest to the average boy or girl. As compared to the benefits to be derived from this kind of teaching, the traditional school study of book physiology is "flat, stale, and unprofitable." What we now most sorely need are teachers of sanitary science who can, by simple laboratory experiments, reveal to the rising generation the sources of most of our contagious and infectious diseases, and who have also sufficient knowledge of sanitary engineering to describe the most approved preventive remedies. There is no doubt but our total death-rate could be cut down one-third, and our bodily diseases one-half, by suitable provisions against these insidious but now known sources of disease and death. But the cry is that we have no teachers for these subjects. This is true. It therefore devolves upon the only competent state agency to furnish these teachers, and this agency is the state university.

II.—Establishment of Courses in Chemical Engineering.

Chemistry, like electricity, now enters largely into nearly all manufacturing processes, and the saving of by-products is usually a question of chemical engineering only. It is one thing to perform a chemical experiment in a laboratory, in a small way, where the economy of the operation does not enter at all, and an altogther different thing to devise ways and means by which the same thing can be done continuously, on a large scale, in a factory, at such a cost as to make the operation profitable. The man who can do both of these things is the chemical engineer. There are schools in Germany where industrial chemistry and mechanical engineering are taught to the same students, thus giving them the necessary schooling to enable them to become, by practice, able chemical engineers. There are beginning to be movements in this direction in America, but few or none of our state universities have entered vigorously this most promising and fruitful field. As a matter of fact, the chemist must devise his appliances in a large proportion of the problems arising in actual practice, and the highest mechanical ingenuity is often required to effect a solution. In all such cases failure is certain unless the chemist is also an expert mechanical engineer. Whenever these two kinds of ability have been embodied in the same individual, and these coupled with a reasonable amount of executive power, the fortunate possessor has not only attained to wealth and fame, but he has proved a blessing to all the industries with which he has been connected. Any person at all acquainted with our industrial progress can call to mind numerous instances in support of this statement. Furthermore, there are untold realms remaining to be conquered by this potential giant, the chemical engineer. One special field of chemical engineering, metallurgy, has been well supplied with capable men, for metallurgical engineering has long been well taught in our mining engineering schools, and in the department of chemical engineering which I hope to see established at the University of Wisconsin, metallurgical engineering should be a course to itself. In other courses of this department would be taught the applications of chemistry and mechanical engineering to the manufacture and testing of various products, such as sugar, glucose, starch, glue, soda, soap, wood-pulp, paper, Portland cement, leather, paints, varnishes, dyes, tobacco, beer, spirits, chemicals, illuminating gas, and a hundred other commodities of daily use. It is in this field of technical education that we are farthest behind Germany. In all other lines of engineering we have much less to learn from them, as I have had occasion to see from a recent visit to all the leading engineering schools of Germany and Switzerland.

III.—Engineering School Extension Work.

The third field into which I shall hope to see our state universities extend their activities is that of the technical education of young men employed in our manufacturing industries. In another place* I have enlarged upon the necessity of giving to our industrial leaders and workers a much higher scientific and technical education than they now possess. Germany has set a pattern in this respect far in advance of the rest of the world. While we shall probably not try to imitate their system of trade—and monotechnic—schools to any very great extent, we must, in my opinion, do something to give to our industrial leaders a better scientific and technical training than they have heretofore been able to obtain. A large proportion of these leaders in our manufacturing industries will always be men who have grown up in the business, from the lowest and most humble positions. Their previous schooling will have been very limited, and the problem we have to face is how to give to these exceptional men of marked abilities a reasonable amount of scientific training in the line of their future employment. In my opinion the problem is already solving itself, as is the case with so many of our unsolved problems in this land of quick initiative and free opportunity. In place of the trade night-schools of Europe we have developed here in the United States, in the course of a very few years, under private initiative and direction, a series of correspondence technical schools, with an enormous patronage.† These schools, though few in number, now carry on their rolls over 100,000 students, these being scattered in all parts of the United States and Canada. Instruction is given wholly by means of special manuals, and by correspondence. Though some of these schools greatly magnify their work, and some are positive frauds, and all their students have, perhaps, too exalted an opinion of their accomplishments, yet they are reaching a class who could not leave their employment to attend other schools, and a good correspondence school can do a great deal for them. No regular technical school has as yet undertaken to do such work by correspondence, and I do not now advocate our entering this field. I should prefer to leave all this work in the hands of the men who have discovered the needs and the methods of satisfying them. So long as they do not grant degrees the state cannot, perhaps, interfere in their management. Their authority to grant degrees, however, if such be ever conferred, should be coupled with a rigid state supervisory control. The fact that they are enormously profitable, however, may lead to such fraudulent practices that the state may be called upon to enter this field also. In that case, these state correspondence schools should not become an organic part of, but should be under the advisory direction of, the state university. In order that no confusion should arise in the minds of the public between the correspondence and the intra-mural schools, the headquarters of the correspondence schools should be located at some commercial or geographical center entirely away from the seat of the state university. All such extensive technical instruction, however, should be under the control of a Board, on which the technical departments of the state university should be well represented. It might well be that evening classes would be conducted at the headquarters of the correspondence schools, although, in my opinion, the correspondence plan has great advantages over any system of evening schools, for men employed through the day in factory, shop or office.

Perhaps the most striking thing about these correspondence technical schools is the great army of young men who are seeking an education in this way. After making liberal discounts for the dull, the shallow, and the indolent among them, we would still have left from ten to twenty thousand poor young men of native ability, of persistent earnestness, and of great promise, who are struggling against heavy odds to acquire a scientific and technical education, in these correspondence schools, as the only means open to them for this purpose.

In addition to these schools we have in this country trade, scientific, and technical journals ad infinitum, and every ambitious boy or man can readily take one or more of these weeklies, which usually contain a considerable amount of good educational matter. Again, we are coming to have, in all populous centers in this country, good free public libraries, which are great educational engines, the good work of which in industrial lines has never, I fear, been adequately appreciated by the rest of the community.

And finally, we have adopted in America the free manual training school as best suited to the American boy, whose career is what he chooses to make it, rather than what has been predestined for him by the conventionalities of society.

Now, with all these agencies open to nearly every American boy, you may ask where does the state university find a suitable field for exercising its functions on these same young manufacturers? In my opinion, the state university can do much in the way of directing and inducing these young men to avail themselves of these opportunities, and in the way of supplementing them.

*Condensed from an address by J. B. Johnson, M. Am. Soc. C. E., on the occasion of his Inauguration as Dean of the College of Mechanics and Engineering, of the University of Wisconsin, Madison, Oct. 14, 1899. The complete address will be published in full by the University.

*In a Presidential address before the Society for the Promotion of Engineering Education, Boston meeting, August, 1898 (Engineering News, Aug. 18, 1898). Copies of this address can be had by applying to the author.

†See a paper by Prof. Edgar Marburg, before the Society for the Promotion of Engineering Education, published in Engineering News, Aug. 24, 1899.

The great defect of the correspondence school, of the technical journal, and of the public library as educational agencies, lies in the entire absence in them of experimental laboratory verification. This the state can very properly supply. By joint action of state and city, these experimental shops and laboratories could be established in every manufacturing center, and if placed under a common state board they could all be made to work in harmony with the private or state correspondence technical schools. If the use of these shops and laboratories be predicated always upon adequate theoretical accomplishment, as shown by examinations, and if such students were admitted at all times, both day and evening, for such periods as they might choose to employ in this way, thus enabling them to so employ their vacations, their evenings, or periods of enforced idleness, from time to time, I believe in a few years a large number of young men regularly employed in business and in the trades, would avail themselves of these opportunities to the great advantage of themselves and of society at large. The test examinations need be only sufficient to show that the applicant knows enough of the subject to safely handle the apparatus and to reduce and interpret his results. As no certificate of proficiency would be given by the state, a much smaller and narrower theoretical knowledge would be accepted from these students than would be demanded from our regular students in the university courses. If such technical education agencies be inaugurated, and well advertised throughout the state, I believe it would result in a great many ambitious young men setting themselves to work in the correspondence schools to prepare for these opportunities. These test examinations would serve, also, as a check upon the thoroughness of the instruction given in the correspondence schools, and it might well be that certificates from some of these schools could be received as evidence of a sufficient proficiency to enable the student to pursue his laboratory studies at these state laboratories and shops. In this way the technical work of the state could be very greatly enlarged, at a comparatively small cost for the instruction given, and an additional stimulus offered to every ambitious boy, however poor, to obtain a fair technical education along the lines of his chosen pursuit. In many cases his employer would gladly pay his expenses for a short experimental course at these state laboratories, in order to have the benefits of his increased efficiency in the work. In this way, also, the technical instruction of the states may be brought home to the manufacturing interests, just as our agricultural school is now intimately related to all the farming interests of the state. This action would in no sense lower, or compromise, the instruction given in the professional engineering schools, neither would there be a disposition, on the part of our engineering students, to revert to these short experimental courses. On the contrary, I should expect to see a goodly number of those who enter upon this more elementary technical education become so enamored of the work, that they would, at whatever sacrifice, regularly prepare for the engineering college, and come up to the university and complete these full engineering courses. If this should prove to be the case in but few instances, it would be a great gain to society, since these are the men who, when properly educated, are sure to become leaders in their respective callings. The collateral advantages resulting from bringing the work of the university into more intimate relations with the productive industries of the state, through its supervisory relation to these more elementary agencies, would also be not the least of the benefits resulting from such an extension of the technical instruction imparted by the state.

IV.—Colleges of Commerce.

The fourth new technical department which I should like to see established under every state university is a College of Commerce. By this I mean something very different from the ordinary commercial college, of which we have enough and to spare. By a college of commerce I mean a college in fact, devoted, however, to imparting that kind of technical education most useful to the business man whose dealings reach beyond our national limits. What may be called Commercial High Schools are also required for the education of boys for domestic commerce, but of these I do not now speak. Hitherto we have been so fully employed supplying home demands that we have not cared to exploit the foreign market, but the time is at hand when a very large foreign trade can be ours if we properly qualify ourselves to go up and possess it. Our consular reports are full of calls for American goods, coupled with bitter complaints, however, of American ignorance and stupidity in the tentative efforts which have been made to meet these demands. The fact is we are not now qualified to do this business, neither have we the material from which to select our foreign United States consuls. As a rule our consuls, our business men, our manufacturers, and their clerical assistants, know no foreign language, and are quite ignorant of the products, the manners, the laws, the customs-regulations, and the shipping facilities and practices of the countries to which they are sent, or with which they may be trying to do business. Most of them are also comparatively ignorant of the commercial laws or our own states, as well as the physical and chemical properties of the products they have to pass upon or deal in or manufacture, and of the adulterations, and the under-valuation for customs-house purposes to which they are subject.

Under the action of the inexorable law of the survival of the fittest, those who are best qualified to do the business in a particular field will get the business to do. Now all the leading continental countries of Europe have established these high-grade colleges of commerce, and their graduates soon come to take responsible positions either in the foreign consular service or in large business establishments. The oldest of these is the one at Antwerp, which is now some 45 years old, and to which young men come from all parts of the world. So highly is the work of this school held by the Belgian government that all the foreign consuls and consular agents of that government must be graduates of the Antwerp College of Commerce, or of its equivalent, and while this address was in preparation word comes through the daily press that the German government is preparing a bill to be passed at the next meeting of the Reichstag which provides that in future all appointees to German consular positions must be graduates of one of these colleges of commerce, of which Germany now has several. These countries not only see that a special, or technical, education is necessary to the adequate preparation of a man to serve his country as a foreign consul, or business agent of the state, but they also see that the college of commerce offers the only means for acquiring this special training. Now that education which can best fit men for the foreign business of the state is also, it would seem, the education which would best fit men for the management of the foreign department of any large manufacturing or commercial business. Of course, the business itself must be learned, either before or after attending the college, but that a course of study in such a college would give to the young man completing it an immense advantage over his fellows, cannot be doubted.

I have now outlined four hitherto unrecognized functions of the state university. Doubtless some will claim they are all outside the legitimate scope of any university, state or otherwise. My answer is that the people of the state should be consulted in this matter. If they desire these educational opportunities, and choose to put them in charge of the state university, it is not for the officers and faculties thereof to refuse. We should have to admit, I think, that the university was made for the state and not the state for the university. If the state wants these subjects taught, in my opinion, they can be most effectively and most economically taught as departments of the state university. Wisconsin has, very wisely, I think, kept its agricultural college under the fostering care of the state university, and I can see no reason why these industrial and commercial courses should not also become part of the great and all-inclusive work of these same institutions. The educational work of the state should not be handicapped by traditions, or limited by precedent or prejudice. It should be as free as the air and as open as the sky.

We are indeed living in a new world, and our country has apparently entered upon a new and broader life, however loth some of us are to leave our old moorings. It is but ordinary prudence for us to prepare the rising generation, as best we can, to meet their larger responsibilities. Both the technical and the business man of the future must have a much broader outlook upon the world of science and of affairs than has sufficed hitherto. The whole round world is the stage on which his drama of life is to be enacted. And while the years of a man's life will remain about the same the intensity of it will be vastly increased. The extra years of preparation required to take these school courses herein outlined will prove a great saving of time and care by making those things easy which otherwise are hard if not impossible. While schooling is not native ability or aptitude, neither does it replace business experience, yet given the aptitude, the schooling enables one to master quickly the details of a business, and to safely carry it to greater heights of success and to wider limits of utility than the same man could do without it. In other words, schooling in any practical subject, when properly adapted to its ends, is the very quintessence of experience. It is the experience of others, digested, boiled down, and generalized into laws of practice and rules of custom, which embody the acquired wisdom of the race in such matters. No one will dare affirm that we should not learn from the experience of others. He is in fact a fool who learns only from his own experience. But schooling in practical matters is simply a scientific way of learning from the experience of others. The school is a kind of concentrated experience transmitter, and if a young man has selected a particular field of activity for his future career, he should get all the schooling he can in this direction, and thus start on his way with all the advantages which may be derived from the experience of those who have gone the same way before him.

DOOR FASTENINGS FOR END-DUMP CARS.

By J. E. Johnson, Jr., M. Am. Inst. Min. E.

Cars of the general type shown by the illustrations in Fig. 1, were introduced about 17 years ago at the works of the Longdale Iron Co.,* for carrying the slag or cinder away from the blast furnaces. This waste product is run into trenches

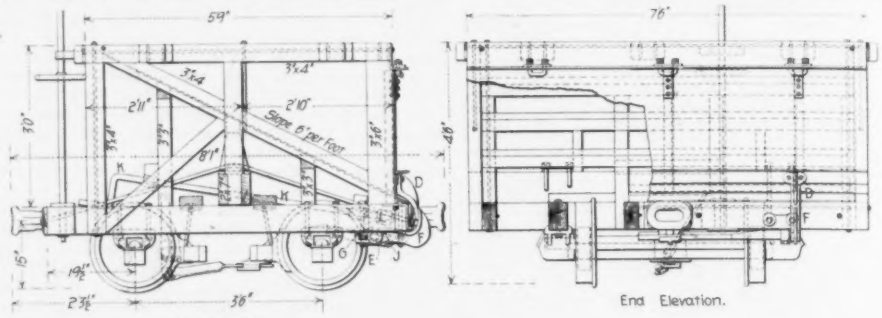


FIG. 1.—END-DUMP CINDER CAR OF THE LONGDALE IRON CO.

in loose coke breeze, and when it is cool enough to be solid, but not sufficiently so to be too brittle, it is "snapped" from these runs by men with hooks. The pieces are of varying lengths up to 4 ft., and are thrown into a yard floored with plates, and from these loaded into cars of the type shown.

The object of the somewhat peculiar design of car was to get a maximum of capacity with a minimum of height, and to have a car which

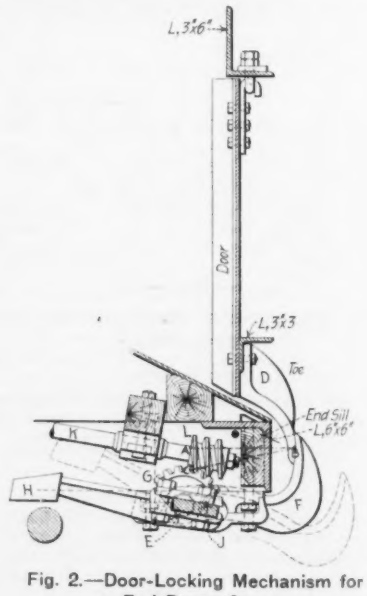


Fig. 2.—Door-Locking Mechanism for End-Dump Car.

should be quite self-dumping and should dump in front. This latter is an important condition, since the bank or dump cannot be carried ahead with all side-dump cars except by shoveling the material. The dump is made as wide as necessary for the track by the use of this type of car, and is carried ahead with a minimum of labor.

These cars were first made with wooden doors, battened, and lined with ⅛-in. sheet iron to pre-

*Longdale, Alleghany Co., Va.

vent wear and to protect the doors from being burnt up, since the cinder is frequently put into them red-hot. The sides and bottom are of ¼-in. iron. The top member of the frame in front was of wood, 4 × 6 ins., and supported by a cast-iron post in the center. The end sills were also of wood, 6 × 9 ins., placed edgewise, with the top surface beveled to the slope of the bottom. The door was originally held shut by having three slots or pockets, one in the center and one at each end, close to the bottom edge, which slots fitted over staples or eyes, fastened to the frame of the car. Keys through these staples held the door closed.

The keys could not all be removed at once, and removing them one at a time strained the doors severely. They were also frequently lost, and the work of closing the doors so that the keys could be entered was considerable, especially after the doors became sprung or warped.

To cure this trouble four chains were attached to the bottom of the door and passed through holes in the end sill to a winding shaft running

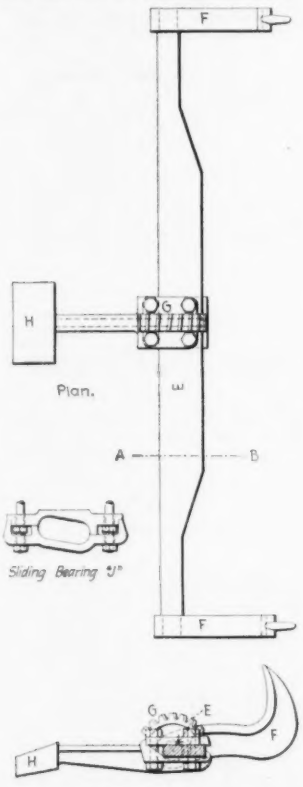


Fig. 3.—Locking Shaft and Hooks, and Slotted Bearings of End Dump Car.

transversely through the car, above and behind the front wheels. The winding shaft was actuated by a worm and worm-wheel, the shaft of the worm passing to the rear end of the car and terminating in a crank-handle. In a short time, however, this plan demonstrated very clearly that it had serious defects. The large lumps of slag hung on the chains and bridged over the opening, so that the discharge of cinder was completely stopped. This occurred with almost every car; and the only remedy was to punch at the offending piece until it was removed. As the dump is not much wider than the car there was little room at the sides, while to go in front was out of the question. This was, therefore, a difficult and tedious operation.

A second disadvantage was that the passage of the cinder put a considerable tension on the chains, and tended to pull the doors shut. This prevented the cinder from being discharged with any velocity, and in consequence it tended to pile up immediately under the car.

These cars were also used for carrying the waste sand removed from the ore washers, and in the winter the water draining from the sand would freeze in the chain-holes through the end sill, thus making it almost impossible to get the door open.

As a result of these difficulties, the design of the car and its door attachments were carefully studied. The central post was found to perform no adequate task, while it was an obstruction to free dumping. It was accordingly abolished altogether. The top member of the frame in front was made of an angle 4 × 6 ins., and the end sill of an angle 6 × 6 ins. The door was made of a single plate, stiffened horizontally by an angle 3 × 3 ins., near the bottom, and vertically by three inside angles, 2 × 2 ins., opposite the hinges on the outside.

Projecting outward and downward from the bottom of the door will be seen two toes (D) at equal distances from the center. Under the bottom of the car frame is a shaft (E), carrying at each end a hook (F), and at the middle a segment of a worm-gear (G), and a counterweight (H). This shaft is held in bearings (J), which have elongated holes (Fig. 3), permitting the shaft to slide sideways as well as to rotate, the longer axis of this bearing being on a slight incline downward to the front. In the center of the car is a worm-shaft (K), on the same slope as these bearings, carrying at its forward end a worm (L) which meshes with the worm-wheel segment (G) on the hook-shaft. The counterweight is somewhat more than sufficient to balance the hooks, so that the tendency is always to force them upwards.

The operation of this device is as follows: Suppose the door to be closed, and held by the projecting toes, as shown by the solid lines in Fig. 2. If the worm-shaft (K) is turned so as to force the top of the wheel (G) forward, the friction of the contact between the hooks (F) and toes (D) will prevent the shaft from rotating. It will, however, move forward bodily, the worm gearing not getting out of mesh because the slope of the bearings and of the worm-shaft is the same. During this motion the wheel simply acts as a segment of a nut on a screw. When the shaft reaches the forward limit of its motion in the slotted bearings (J) the top of the wheel-segment is still forced forward by the worm. The shaft (E) then revolves, the hooks are forced down, off the toes, and the door is released. The extreme position of the hooks in this direction is shown in dotted lines, Fig. 2. After the load is discharged, the door returns by gravity to within an inch or two of its closed position. The direction of rotation of the worm-shaft being reversed, the shaft is released from the front of the bearings, and by the torque due to the counterbalance, aided by the pull on the wheel, it is rotated so that the hooks come up until their shanks strike the lower edge of the angle-iron end-sill. Further rotation being then impossible, the shaft is drawn bodily back in the inclined bearings, the hooks catching the toes on the door in their course and drawing it shut.

No provision is made for holding the shaft exactly at right angles to the axis of the car in all positions. It is given enough end play in the bearings to prevent jamming, and simply slides back as it pleases until the hook at one end engages the corresponding toe. The increased resistance then causes the other end to advance until that hook engages. This insures that both sides of the door shall be held alike, the hook-shaft acting as an equalizer.

This device is entirely satisfactory, and an experience of several months has not indicated any opportunity for improvement. The chain cars required about six minutes each to dump; the new cars require but one minute. The discharge is quite unobstructed and the dump in consequence assumes its proper slope, so that slides are prevented. There is nothing to freeze up,

The toes and hooks were intended to be steel castings, but the experimental ones of cast iron were perfectly satisfactory and are still in service, so that all have been made of this material.

The hook-shaft is made of rectangular cross-section in the central portion, to give the stiffness necessary to withstand the pull of the worm, which only takes place in the direction of the long axis of the rectangle. This also furnishes a convenient method of attaching the worm-wheel and counterbalance. It will be noted that the pull of the worm is transmitted to the shaft by means of lips or jaws cast on the counterweight so that it does not come on the bolts. No machine work is required, except turning the ends of the shaft where the hooks fit, and the drilling of the hooks, all castings being used as they come from the molds.

The working face of the hook is not struck from the center of the eye, but from the point (A) Fig. 2, much higher up, which gives a decided outward flare to it. This causes the thrust of the toe to take a direction tending to force the hook down and off the toe, but this tendency is not so great as would first appear, because the hooks are rigid on the shaft and the force is applied to this, not at the center, but at the top of the worm-wheel. The true angle of action is (A, B, C), in which (B) is the point of contact of the hook and toe, and (C) that of the worm and wheel (Fig. 2).

This angle is about 12°, of which the tangent is 0.2, while the coefficient of friction of the surfaces of the hook and toe is at least .40. This prevents accidental unlocking, while the downward thrust of these surfaces greatly assists in unlocking when the worm is turned for this purpose. This device is capable of application, with some slight modification, to some types of side-dump cars. It is not and will not be patented.

CONSTRUCTION AND MAINTENANCE OF STREET RAILWAY TRACKS.*

The rails should be not less than 6 ins. in depth with a width of base equal to the exposed upper surface. Where streets are paved with asphalt and a stone toothing course is placed adjacent to the rails, the rails must be at least 9 ins. in depth in order that the base may be securely embedded in the concrete below. Rails should be center bearing,‡ rolled in 60-ft. lengths and handled so that they will be perfectly straight when placed in final location.

Tie-rods 1 in. in diameter should be placed 6 ft. apart, c. to c., along the line, supplied with hexagon nuts which, when in place, should clamp the rails securely on both sides. The tie-rod threads should extend far enough from the rod ends to allow the rod to be put in place without bending it. The theory of this rigid tie-rod is that the street traffic and pressure on the outside of the rails should be provided against as well as the car thrusts on the inside. The top of the tie-rod should be placed at the center between the top and bottom of rails to better accommodate the paving, especially if brick or stone is adopted for the wearing surface.

In the track system of the Metropolitan St. Ry., of Kansas City, the construction for rail foundations consists of digging a trench 20 ins. wide on top and 16 ins. wide on the bottom, with enough depth to get 6 ins. below the rails when they are at the established grade. In this trench, at 10-ft. intervals, are placed wooden blocks, 8 × 10 × 16 ins., and the rails are spiked securely to these blocks, which serve to hold the rails while same are being laid and tamped to surface, the joints being held in position by temporary splices.

After nicely gaging, alining and surfacing the track, the trenches are filled with concrete, bedding the base of the rails up to the bottom of the proposed paving. This concrete is composed of ¼-in. crushed stone mixed with Portland and domestic cement and sand. The proportions are 4 parts sand, 1 part Portland cement, 1 part domestic cement and 10 parts crushed rock, all by measure. Great care should be taken to get the mortar flushed close against the rails and to bring it full up under rail trams. The concrete in the trenches should be allowed about six days to set; this, however, depends upon the condition of the atmosphere, as it sets much more rapidly in warm than in cold or chilly weather.

The concrete for the paving foundation may be composed of 1 part domestic cement, 2 parts sand and 4 parts broken stone by measure, the broken stone to be not larger than 2½ ins. in the greatest dimensions. All concrete to be thoroughly tamped till mortar flushes to surface.

After the concrete is set, cast weld joints shall be formed at all joints including the special work which may be needed. The cast weld joint on 80-lb. rails should weigh 150 lbs. and on 100-lb. rails, 200 lbs. additional metal; the additional metal to be composed of two-thirds pig iron and one-third common scrap iron. The metal should be heated to a bright yellow temperature and each joint formed with one pouring. The depressing clamps should remain in place for at least one hour after the pouring, and the surface of the rails should finally be dressed smooth so that the passage of the car will be the

*Abstract of a paper presented at the annual convention of the American Street Railway Association, in Chicago, by Mr. Edward Butts, Metropolitan Street Ry. Co., Kansas City, Mo.

‡The author evidently means that the gage side of the rail head should be over the web of the rail. The form of rail section known as "center-bearing" is now practically obsolete.

same as on a continuous rail. In preparing the joint, better results as to smoothness are obtained by inserting a thin shim between the rails, than by placing the rails too close to admit such a shim. These cast welded joints should be so formed as to admit the wearing surface of the pavement with least amount of interference practicable.

As a general proposition the wearing surface of the paving should be composed of the same material as the balance of the street, otherwise there will be an undue amount of vehicle travel on the street railway tracks and there will be more accidents, as well as less durability of the wearing surface. For instance, if the street is paved with asphalt and the track with brick or stone, heavy loads on slight grades will be driven on the stone or brick because the latter material furnishes a better footing and keeps the grease well in play in the wheel boxes. On the contrary, if the street railway tracks are paved with asphalt and the street roadway with brick or stone the drivers of light vehicles, as well as some of the other class, will immediately seek to occupy the street railway tracks.

At all times attention should be paid to drainage, and at street crossings, where the established grade is level, the surface of the tracks on one side should be elevated several inches to prevent the retention of water pools. At all changes of grade the rails should be bent to form vertical curves, and no joints allowed in such vertical curves, as it is almost impracticable to form a uniform curve unless shop work is resorted to. There is no economy in trying to construct a railway too hastily, as in so doing inferior work is generally put in and a future expense is the result.

The special work, turnouts, crossings and crossovers should be of cast-steel construction, except at steam railway crossings, which are best made of regular built-up work located on the foundation. The tongue of turnout switches should be placed on the high or superelevated rail of the curves, otherwise the guard rail of the mate should extend full length of the casting on which the tongue is located. All curves of a radius under 300 ft. should be provided with guard rail, and curves of less than 50 ft. radius should be double guarded.

A very important item as a matter of economy in the construction of street railways is the contract and specifications. This document should cover, without doubt, all that is intended to complete the whole line, and in street railway construction there is so much to consider that often items are left out or neglected which finally become very serious and costly matters. In the matter of maintenance, when a line is constructed as herein provided, the maintenance question is thrown almost entirely on car equipment, involving the several items, wheel base, double or single trucks, diameter of wheels, properly applied springs and height of cars. The longer the wheel base the less durable the curve. Single trucks will batter out frogs, switches and joints more rapidly than double trucks. This last also applies to diameter of wheels, weight of cars and last, but not least, the springs between the trucks and car body.

Discussion.

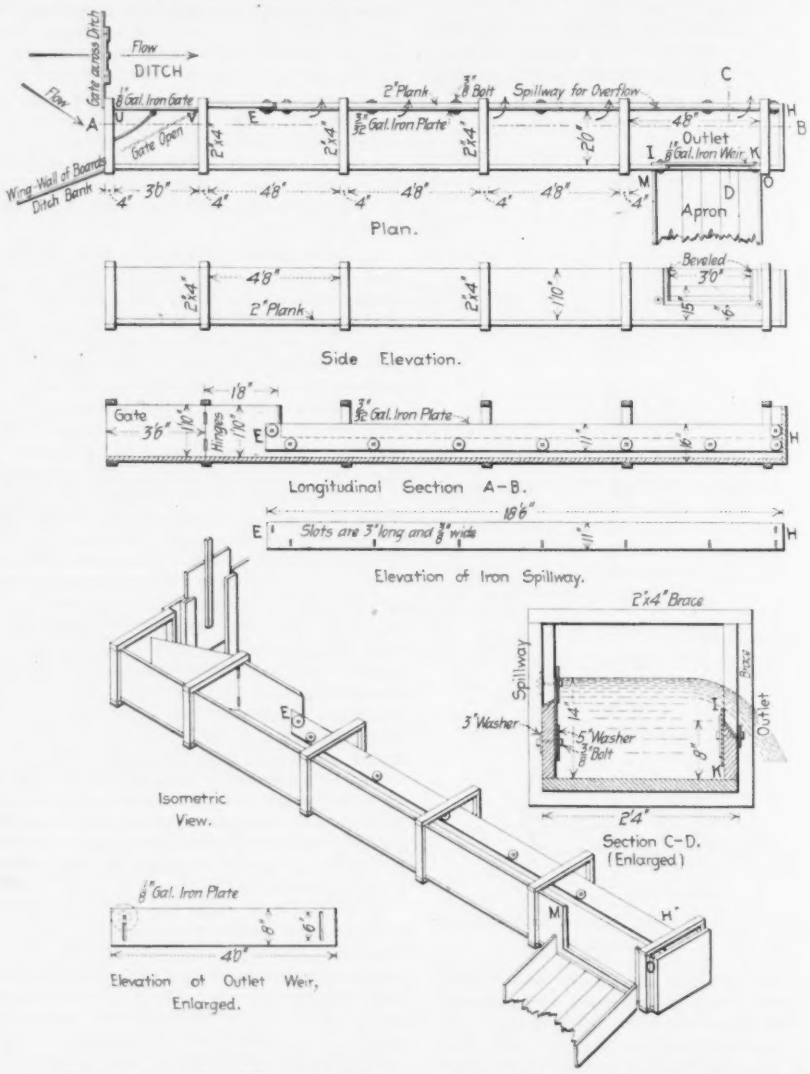
Mr. Foster (Lynn, Mass.)—The paper states that the girder rail is laid on wooden blocks, which are then surrounded with concrete. It seems to me that it would be better to lay the rail on concrete entirely.

Mr. Holmes (Kansas City, Mo.)—Mr. Butts should have explained that these blocks are only used for the purpose of alinement, the small blocks are put in to line the track, but not to support the rail.

Mr. Foster—The subject of cross-ties is one which is met with in almost every section of the country, as over 90% of the roads are using cross-ties. Some roads use a tie 6 ft. 6 ins. long, 5 × 7 ins., placing them from 24 to 30 ins. c. to c. For a T-rail, where you are going to operate at a high rate of speed, as many of the electric roads are doing, it seems to me that we should use a tie of about the same dimensions as the ties used on the steam railways. We are constructing five miles of double track with the T-rail, using ties 6 × 7 ins. to 6 × 10 ins. and 8 ft. long, being practically a steam railway tie. The 70-lb. rail is of the American Society of Civil Engineers' section. Girder rails we have to lay on cross-ties in our section of the country, and they are 5 × 6 ins., and 6½ to 7 ft. long. I do not understand why in some cases it is thought a tie 6½ ft. long should be sufficient. We have some 45-lb. girder rail made in 1890, which was put on a steel chair on a small tie, 4 × 5 ins., 6½ ft. long, 3 ft. c. to c., and that was thought to be a good construction at that time. Time has shown that this practice is bad, and now the problem with us is how to perpetuate that rail to the best advantage. The lips of the steel chairs have become worn to such an extent that they do not hold the rail securely. We do not believe it wise to purchase new steel chairs, so we have been substituting the old-fashioned stringer for the chairs, knowing that we can obtain from six to seven years' life in the stringer, and thereby get six or seven years more wear out of the rail. The head of the rail is worn but very little. I believe this to be economical under some conditions of light traffic. We use many of the soft woods, such as cedar and hackmatack, but think that the best results have been obtained from the use of a chestnut tie.

Mr. Keating (Toronto)—This discussion raises a very important question as to the advisability of rigid construction on lines where there is heavy traffic. I have had occasion to construct some lines upon a concrete foundation where the traffic has not been excessively heavy. The results so far have been very favorable indeed, but it would be very interesting to learn from some cities, where they have adopted this rigid method of construction, whether any observations are taken to determine if there is any yielding in the rail at all. I have had observations taken on other lines, and find that the give in the rail is very considerable. Of course, where there is heavy travel this method of rigid construction has been adopted, but it is a question if it does not affect the rolling stock.

Mr. Butts—We have operated a road with concrete foundations the past four years, and there is no perceptible tremor or deflection, or yielding of the rail. We have been constructing track on this system continuously every year from that time up to the present day, and we



DETAILS OF MODIFIED FORM OF FOOTE'S EXCESS WEIR, OR SPILL-BOX.
W. Newbrough, Engineer.

are still continuing to construct that kind of track. In regard to the cast-welded joint and the expansion and contraction of the rails, I would say that our method has been to put the concrete around the rails before the welded joint is put on. That holds the rail perfectly in place, and there is no displacement on straight lines, although we have to do some little extra work on curves on account of cast-welded joints on the curves. This was because of putting joints in too soon, before the concrete had settled thoroughly. We concrete the track, and leave an aperture where the welded joint is to be placed. After the concrete has set a sufficient time, we go along with the welding machine and cast-weld the joints.

Mr. Holmes (Kansas City)—In constructing this track, we use portable crossovers, and cut out a certain length of track, say 1,000 ft., depending on the traffic on the line. The cars going in both directions use that one track for that distance.

Mr. Wason (Cleveland, O.)—There are one or two points which have developed in the use of the cast-welded joint track that we have laid in Cleveland, which hardly encourage us to continue its use. We have also tried electric welding of the joints, but have been unable to keep perfect alinement, gage or surface. The track which we have put together with the twelve-bolt fish-plate has proved much more satisfactory than the cast-welded joint. We have a very liberal supply of ties with very careful tamping. Now we are using concrete around and underneath the ties, allowing it to set and afterwards filling up underneath the rail. I do not think we will use the cast-welded joint any longer, but depend entirely on the 12-bolt fish-plate to hold the track in line.

Mr. MacGregor (Houston, Tex.)—In speaking on this rail question, the big roads have set a pace requiring a 9-in. rail. I have been using a 6-in. T-rail. I wanted to get a girder rail to correspond with that, but the supply people cannot furnish it. They will give you a 4-in base. I do not think anyone running an electric railway desires to put down a rail with only 4 ins. base. I want a wide base and a modern head to the rail, but the supply men say that everything is 6 ins., which is too heavy and expensive for a small road. We have no ballast down

are still continuing to construct that kind of track. In regard to the cast-welded joint and the expansion and contraction of the rails, I would say that our method has been to put the concrete around the rails before the welded joint is put on. That holds the rail perfectly in place, and there is no displacement on straight lines, although we have to do some little extra work on curves on account of cast-welded joints on the curves. This was because of putting joints in too soon, before the concrete had settled thoroughly. We concrete the track, and leave an aperture where the welded joint is to be placed. After the concrete has set a sufficient time, we go along with the welding machine and cast-weld the joints.

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Mr. Wason (Cleveland, O.)—There are one or two points which have developed in the use of the cast-welded joint track that we have laid in Cleveland, which hardly encourage us to continue its use. We have also tried our way. We use cypress ties which are creosoted. My experience has been that the lengthening out of the tie from 7 ft. to 8 ft. does not benefit us. With the question of bonding is brought up the question of the experience with the cast-welded joints outside of the paved streets. I am putting in cast joints, but I have not the experience to enable me to express an opinion on the results yet.

Mr. Heidelberg (Chicago)—In 1895 we started to put the cast-welded joint on our road, and it has been satisfactory as to the alinement and level of the track. I will call your attention to some track that was laid last week, on 18th St., from Wabash Ave. to Indiana Ave., and on Indiana Ave., from 18th St. to 39th St. We have ten miles of this track on Halsted St., from Archer Ave. to 69th St., done this summer, and I do not think that you will find one joint out of alinement or out of level. I find that the creosoted cedar or hemlock tie is the only tie to use in sand, whereas in a clayey soil we use white oak. We use ties 5 × 8 ins., 7 ft. long, chisel-point spikes and side-brace tie-plates. We laid a great deal of 90-lb. 9-in. rail, but it did not give us satisfaction. We also found that the web was too thin for the height, and with the extreme changes we have here, these rails would pull

and break. Mr. Butts stated that he poured the metal at a bright yellow heat. My instructions are to my men to pour no metal into a mold until it is at a white heat. If it is not at a white heat they are to make a pig of it. The essential point is that, after sand-blasting the joint and getting all the parts of the rail perfectly clean, you must have your metal very hot in order to flux and amalgamate with the rail. If you do not do that you are not sure of a bond. When you do it, and have a man watch and see that the metal is at a perfect heat, then your bond is sure, for we have made a great many tests and have not found any defective bonds when this method is carried out. In the maintenance of railway tracks it is very essential to have a thorough organization of all the men under you, so that you can get them together at any time. We have a track master and six section foremen, giving nearly 40 miles of road to each section. We have a caller on each section. The telephone operator at the main office calls simply this one man on each section, a man who lives near to the barn, and he calls all the rest of the men and tells them where to go. These things are very essential in a country where you are liable to get a snowstorm in 30 minutes.

Mr. Butts—In answering some of the questions, I would say that I have not advocated in this paper anything less than a 6-in. rail. We have not experienced any breakage of welded joints, and we have welded not less than 3,000.

A MODIFICATION OF FOOTE'S IRRIGATION EXCESS WEIR OR SPILLBOX.

The excess weir for use on irrigation canals devised by Mr. A. D. Foote, M. Am. Soc. C. E., and generously turned over to the profession in 1886, without patents, has been quite widely used throughout the West, sometimes with modifications.* We are indebted to Mr. W. Newbrough, of Evanston, Wyo., for the following illustrated description of certain modifications in the weir which he has made recently:

The first modifications made by the writer were to substitute a weir of given length at the outlet (M O on the drawing), and to regulate the height of the water flowing over it by a spillway weir, E H. It was found that it was difficult to set the spillbox level in the side of a ditch, and still more difficult to have it remain so. The idea occurred that the weirs might be made of galvanized iron, and made movable in a vertical direction by means of slots, bolts and washers, as shown in the drawing; then, if the box settled unequally, the weirs could be leveled independently.

The accompanying drawing is a design for a general box, that will deliver anywhere from 0.25 to 3.42 cu. ft. per sec., according to the difference in height between the weirs. The drawing shows the weirs in the positions for a discharge of 3.42 cu. ft. per sec.

If it is required to deliver at all times a constant quantity, it will not be necessary to make the slots in the outlet weir I K more than 3 ins. long. Should this quantity be anything less than 1 cu. ft. per sec., it will not be necessary to make the weir over 16 ft. long, 14 ins. wide and 14 ins. high, on the inside. It should always be remembered that a decrease in the length or width causes a decrease in accuracy, owing to the diminution of the length of the spillway, and to the increase of the velocity of approach.

In setting the box the following remarks should be noted:

1. Set the box as level as possible and on a firm foundation. If in the ditch bank all openings should be tamped with sod and it may be advisable to drive short sheet piles on the spill-board side, with an apron to receive the overflow.
2. Arrange the spill-board weir at the requisite height above the outlet weir to give the required discharge; level both weirs and bolt them tight.
3. It is advisable to have a bar, wing-nut and lock upon the gate U V. The water from the ditch will enter the box with some velocity; commence to run out of the outlet weir, and rising higher, will begin to run out of the upper end of the spill weir, until it spills over the whole of it. The gate U V should now be closed until a very little (the less the better) spills over the end, F, and then locked.
4. After settling, if the box is not level, let it remain so, and level up the weirs. Every few days test the weirs with a carpenter's level, and keep them horizontal.

The accompanying table, based upon the Bulletin No. 27, of the experiment station of the Colorado State Agricultural College, on "The Measurement and Division of Water," by Prof. L. G. Carpenter, gives the discharge at the outlet. Intermediate values can be interpolated. These values only hold good when the outlet weir is exactly 3 ft. long.

Any necessary changes can be made by an intelligent carpenter using the drawing as a guide. In making these changes, keep the spill weir as long as possible and the box as wide as possible, and do not change the length of the outlet weir without consulting a table of weir discharges, such as is given in the above-mentioned bulletin.

It is hardly necessary to say that the water in the ditch should be brought to as low a velocity as possible and raised so it will enter the box by means of a weir and gate, which is indicated at the head of the box.

*See Eng. News, Nov. 13, 1886, and Trans. Am. Soc. C. E., Vol. XVI., p. 134. Also, especially for some of the modifications, Bulletin No. 27 (Revision of No. 13) of the Colorado Experiment station, "The Measurement and Division of Water," by Prof. L. G. Carpenter, Fort Collins, Colo. The original weir is also described in Wilson's "Manual of Irrigation Engineering," p. 85.

Discharge Over 3-ft. Outlet Weir.

Height spill weir above outlet weir.	Discharge per second.	Height spill weir above outlet weir.	Discharge per second.
1 in.	0.25 cu. ft.	3¾ ins.	1.72 cu. ft.
1¼ ins.	0.28 "	4 "	1.88 "
1½ "	0.44 "	4¼ "	2.05 "
1¾ "	0.55 "	4½ "	2.23 "
2 "	0.67 "	4¾ "	2.41 "
2¼ "	0.82 "	5 "	2.62 "
2½ "	0.95 "	5¼ "	2.81 "
2¾ "	1.09 "	5½ "	3.00 "
3 "	1.23 "	5¾ "	3.20 "
3¼ "	1.38 "	6 "	3.42 "
3½ "	1.55 "		

THE LIFE OF TIMBER EMPLOYED IN RAILWAY BRIDGES IN THE UNITED STATES.

The average life of timber in railway bridges was the subject of a committee report presented at the annual convention of the Association of Railway Superintendents of Bridges and Buildings, held this week at Detroit, Mich. As the records given in this report are those of actual experience in nearly all parts of the country, they will, we think, be of interest to engineers. The accompanying Table I. gives the life of piles driven in salt water, fresh water and in dry soil, and Table II. shows the life of bridge timbers when exposed to the weather and when protected, and when located in different parts of the structure:

TABLE I.—Showing Life of Different Kinds of Piles Employed in Railway Bridges and Trestles in United States.

Kind of timber.	Average life in years when driven in—Water—Salt.	Fresh.	Dry land.	State.	Railway company furnishing report.
Cedar, white	.....	.....	Over 20	Wisconsin	Chicago, Milwaukee & St. Paul.
Cedar	.....	28	16 to 20	"	Chicago & Northwestern.
Cedar	.....	.....	20	"	Chicago & Northwestern.
Cedar	.....	20	20	Wyoming	Union Pacific.
Chestnut	40	20	15 to 18	Me.,N.H.,Vt.,Mass.	Boston & Maine.
Chestnut	15	15	12	Rhode Island	New York, New Haven & Hartford.
Cypress	.....	.....	7	Illinois	St. Louis, Peoria & Northern.
Oak	35 to 40	8 to 10	About 12	Massachusetts	Boston & Maine.
"	.....	20	14	New Hampshire	Boston & Maine.
"	9	9	8	Rhode Island	New York, New Haven & Hartford.
" white	.....	8 (wtr line.	10	Ohio, Ind., Ill.	Toledo, St. Louis & Kansas City.
" "	.....	15 to 30	8 to 12	Illinois	Chicago & Eastern Illinois.
" "	.....	.....	8	Ilinois	St. Louis, Peoria & Northern.
"	.....	.....	5 to 20	S. Dak., Minn.	Chicago & Northwestern.
" white (best quality)	.....	.....	20	Wisconsin	Chicago, Milwaukee & St. Paul.
" "	.....	25	10 to 14	"	Chicago & Northwestern.
" " (nrth'n grwn)	.....	20	15	"	" "
" " (suth'n ")	.....	10	8	"	" "
" "	.....	20	12	Wyoming	Union Pacific.
Pine, long-leaf yellow	10	10	10	Miss., La.	New Orleans & Northeastern.
" Norway	.....	.....	6	Wisconsin	Chicago, Milwaukee & St. Paul.
" "	.....	7	6	Minnesota	Duluth & Iron Range.
" white	.....	8	7	Minnesota	Duluth & Iron Range.
"	.....	15	8	Wyoming	Union Pacific.
Spruce	.....	10	7 to 8	Me.,N.H.,Vt.,Mass.	Boston & Maine.
"	8 to 10	4 to 6	4 to 6	Massachusetts	Boston & Maine.
" red	.....	10 to 15	8 to 10	Colorado	Denver & Rio Grande.
" "	.....	.....	7	Colorado	Colorado & Southern.
Tamarack	.....	18	10 to 12	Me.,N.H.,Vt.,Mass.	Boston & Maine.
"	.....	.....	8	Wisconsin	Chicago, Milwaukee & St. Paul.
"	.....	.....	8	Minnesota	Duluth & Iron Range.

TABLE II.—Showing Life in Years of Different Kinds of Timber Employed in Railway Bridge Construction in the United States.

Kind of timber.	Exposed to weather. Stringer.	Trestle.	Truss.	Protected from weather. Stringer.	Trestle.	Truss.	State.	Railway furnishing report.
Long-leaf So. pine	12 to 14	15 to 20	15 to 20	Indefntly.	.....	Indefntly.	Me.,N.H.,Vt.,Mass.	Boston & Me.
" " "	10 to 12	12 to 15	12 to 14	.....	.....	.....	Massachusetts	" "
" " "	Good for about 15 years.			Practically as lasting as iron.			New Hampshire	" "
" " "	16	18	15	40 to 50	40 to 50	40 to 50	Rhode Island	N. Y.,N. H. & H.
" " "	.....	9	.....	.....	.....	.....	Alabama	Southern.
" " "	8	8	.....	.....	.....	.....	Miss., La.	N. O. & N. E.
" " "	.....	.....	16 to 17	.....	.....	20	S. Dak., Minn.	C.&N.O.(D. Div.)
" " "	.....	8	.....	.....	.....	.....	Illinois	St. L., P. & N.
" " "	14	.....	.....	.....	.....	.....	Ill., Ind., Ohio	T., St.L. & K. C.
" " "	10	10	10	.....	.....	.....	Colorado	Colo. & Southern
White pine	10 to 12	.....	14 to 18	Indefntly.	.....	Indefntly.	Me.,N.H.,Vt.,Mass.	Boston & Maine.
"	.....	.....	.....	.....	.....	40	Massachusetts	" "
"	.....	.....	.....	.....	.....	40	New Hampshire	" "
"	10	10	10 to 12	.....	.....	.....	Missouri	C., M. & St.P.*
"	.....	.....	10	.....	.....	14	Ohio, Ind., Ill.	T., St.L. & K. C.
"	10 to 12	12 to 14	.....	.....	.....	.....	Illinois	Chic. & East. Ill.
"	8 to 10	8 to 10	8 to 10	.....	.....	30+	Wisconsin	Chic. & N'w'n.
"	10 to 12	13 to 15	16	.....	.....	20+	S. Dak., Minn.	" "
"	10	10	10	.....	.....	.....	Minnesota	Dul. & I. Range.
Eastern pine	12	.....	12	.....	.....	.....	Wyoming	Union Pacific.
Colorado pine	10	8 to 15	.....	.....	.....	.....	Colorado	Den. & Rio G.
Norway pine	10	.....	.....	.....	.....	.....	Wisconsin	C., M. & St. P.
Norway pine	.....	8	8	.....	.....	.....	Minnesota	Dul. & I. Range.
Spruce	6 to 7	.....	8 to 10	40	.....	Indefntly.	Me.,N.H.,Vt.,Mass.	Boston & Maine.
Spruce	.....	5 to 7	.....	.....	.....	.....	Massachusetts	" "
Oregon fir	16	14	10	.....	.....	.....	Wyoming	Union Pacific.
Oregon fir	18	.....	18 to 20	.....	.....	.....	Colorado	Den. & Rio G.
Fir	12	.....	.....	.....	.....	.....	Minnesota	Dul. & I. Range.
White oak	.....	7 to 8 ties & caps.		.....	.....	.....	Ohio, Ind., Ill.	T., St.L. & K. C.
"	.....	14 to 18	.....	.....	.....	.....	Illinois	Chic. & East. Ill.
"	18	.....	.....	.....	.....	.....	Wyoming	Union Pacific.
Red cypress	12	.....	.....	.....	.....	.....	Alabama	Southern.

*Superior Division.

THE RAILWAYS AND TRAMWAYS of New South Wales are the property of the government, and are operated by a Board of Railway Commissioners. The total length includes 7,706 miles of railway, and the 66 miles of tramway or street railway in the city of Sydney. The lines are of standard gage. Negotiation with the other Australian colonies are in progress, with a view to eventually securing a uniformity in gage for the main lines, and a uniformity in practice and in rates. The Sykes lock-and-block system is being introduced on the busy suburban lines, and the fitting of the freight equipment with the Westinghouse quick-acting brake has been practically completed. Considerable work is being done in reducing grades and improving alinements, with very satisfactory results in operation. The total cost per mile of railway was $70,185. In 1899, the earnings and operating expenses per mile were $5,815 and $3,125, the operating expenses being 53.75% of the revenue. The locomotives include heavy ten-wheel and consolidation engines of English and American construction, as well as eight-wheelers, and some 65-ton Mogul saddle-tank engines, with an extra pair of wheels on a radial axle under the cab and coal bunker. The passenger cars are of English and American types, but all mounted on trucks. The freight equipment includes small cars of the English four-wheel type, and long cars of the American type, mounted on trucks. The tramways or street railways include a steam dummy line, cable lines and electric lines with overhead wires. The cars are four-wheeled and eight-wheeled. In view of the limited capacity of the cable system, as compared with electric traction, for rapidly moving an increasing volume of traffic, the conversion of one of the cable lines to electric traction is contemplated. In spite of the fact that the operating expenses consume 82.63% of the revenue, the tramways pay 4% on the capital invested. Of the railways, Mr. W. Thow is Chief Mechanical Engineer, and Mr. Thomas B. Firth is Engineer in Chief, while Mr. Geo. Downe is Locomotive Superintendent, and Mr. G. B. Cowdery is Engineer of the tramways.

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ADVERTISING RATES: 20 cents a line. Want notices, special rates, see page XXII. Changes in standing advertisements must be received by Monday morning; new advertisements, Tuesday morning; transient advertisements by Wednesday morning.

New York city, by its past wholesale gifts of franchise rights to bridge the East River, appears to have placed itself in the somewhat ridiculous position where it must build its own bridges if it gets any, and must, moreover, pay private individuals for the privilege of doing it. The publication of the plans (Eng. News, Oct. 19), for the projected bridge across the East River, at Blackwell's Island, discloses the fact that if the bridge is built before 1901 its construction will involve the purchase by the city of the franchise granted some fifteen years ago to Dr. Thomas Ranney, of familiar recollection. It will be remembered by many of our readers, we presume, that a similar condition of affairs confronted the Commissioners of the New East River Bridge, which is now under construction, when they began work four years ago. In this instance it cost the city $200,000 to regain the privilege of constructing a bridge which had shortly before been bestowed as a gift upon a few shrewd speculators. Just how much the owners of the Blackwell's Island Bridge franchise will be able to mulct the city for, should it insist on going ahead with the construction of the bridge before the end of 1901, it is impossible to say. It would seem to be foolish of them, however, to take any less for their freely obtained privileges than did their predecessors of the "East River Bridge Company"; and if we may judge by the utterances of the New York newspapers, there is little expectation on the part of the general public that they will fail to extract the utmost profit from their present rights that they are able. The one glimmer of hope seems to be that the powers that be will decide to delay the construction of the bridge until the franchise rights, which now stand in the way of free action in this respect, come to the end of their life in 1901.

There certainly seems to be no good reason why the construction of the new bridge might not well be postponed until far later than 1901, as we pointed out in discussing the project in our issue of Dec. 15, 1898; but unfortunately all the efforts of the city officials have so far been exerted in the opposite direction of pushing the work with the utmost haste. The reason given for this great haste is that the bridge will "open up new land for home construction"; but except for the fact that the syndicate of politicians, which has been favored so much in the free gift of bridge franchises during the past few years, are the principal owners of these "lands for home construction," there seems to be no pressing need for their immediate development, which will not be fully satisfied much sooner by the bridge now under construction. From all that has been said, it seems very doubtful, therefore, whether the public can expect much voluntary exertion on the part of the city officials to save the expense of purchasing the Ranney franchise for the Blackwell's Island Bridge, and it would seem to be high time for the people to better themselves to prevent this criminal waste of the public money.

The necessity for such action reaches farther ahead than the present case of the Blackwell's Island Bridge. If the plans of the present city administration are carried out, to build still another bridge across the East River, to be located between the present completed structure and the new bridge which is in process of construction two miles further upstream, there is every likelihood that another franchise owned by private individuals will have to be purchased at a stiff figure. The history of this franchise is an entertaining one from all reports, and will repay study. It was granted by the Legislature of 1892 to the East River Bridge Co., and gave the exclusive privilege to that company to construct a bridge crossing the river at any point between the present Brooklyn Bridge and the U. S. Navy Yard. Besides giving the East River Bridge Co. control over every available location for a bridge for two miles of river front, where there was the most likelihood of a bridge being needed, the franchises contained the further interesting provision that if the company failed in a certain number of years to build a bridge, its "right of construction" should lapse, but it should continue to hold "all other rights, privileges and franchises unaffected." It is needless to say that the East River Bridge Co. did not take any steps to retain its "right of construction," but it has kept a firm grasp on its "other privileges," and has sold one site to the New East River Bridge Commission for $200,000, and still has a well-selected stock of other sites to dispose of in a similar manner, one of which, the third East River bridge, will have to occupy if it is located according to the plans of the city administration. The height of absurdity in granting free and unrestricted franchises to private interests could not go much further than has been disclosed by this condition of affairs in New York city. The situation is one which calls for vigorous action, and the best action to take is to demand that the whole pack of franchises for bridging the East River, which are now owned by private speculators, shall be repealed by the State Legislature at its next session. The owners of these franchises have done nothing with them but to extort money from the taxpayers at every opportunity, and it is high time that these blackmailing privileges should be abolished by the body which created them.

The absurdity and harmfulness of the statement sometimes made in reporting water analyses that no typhoid bacilli, or no germs of disease, were found, has been pointed out in these columns several times. If such statements were not a menace to the public health they might be passed over as mere harmless absurdities. The fact is, however, that such public statements, coming from supposed authoritative sources, create a false sense of security, and in this way are likely to do real harm. In view of the importance of the subject, and in the hope of aiding to a right understanding of the matter, we give the following extract from one of the foremost English authorities upon bacteriology as related to water supply, the extract being from a recent address by Prof. Percy F. Frankland before the Section of Physics, Chemistry and Biology of the Sanitary Institute of Great Britain:

Indeed, the detection of specific pathogenic bacteria in drinking water is now known to be almost beyond the range of practical politics, and the search for such bacteria is, in general, only carried on in deference to the special request of the layman, the uninitiated, or the hopelessly ignorant, while it cannot be repeated often enough that any feeling of security which may be gathered from an unsuccessful search for pathogenic bacteria is wholly illusory and in the highest degree dangerous.

That bacteriology is of great value, when properly applied to the study of water supplies, Professor Frankland has most convincingly shown by his own researches and writings for years past. In the address in question, after giving the warning just quoted, Prof. Frankland says that by far the greatest service rendered by bacteriology in water supply matters is in connection with filtration, where it forms a most certain and reliable test of the efficiency of any given plant, at once laying bare "the slightest irregularity or defect in the process."

THE REVOLUTION IN RAILWAY TRANSPORTATION.

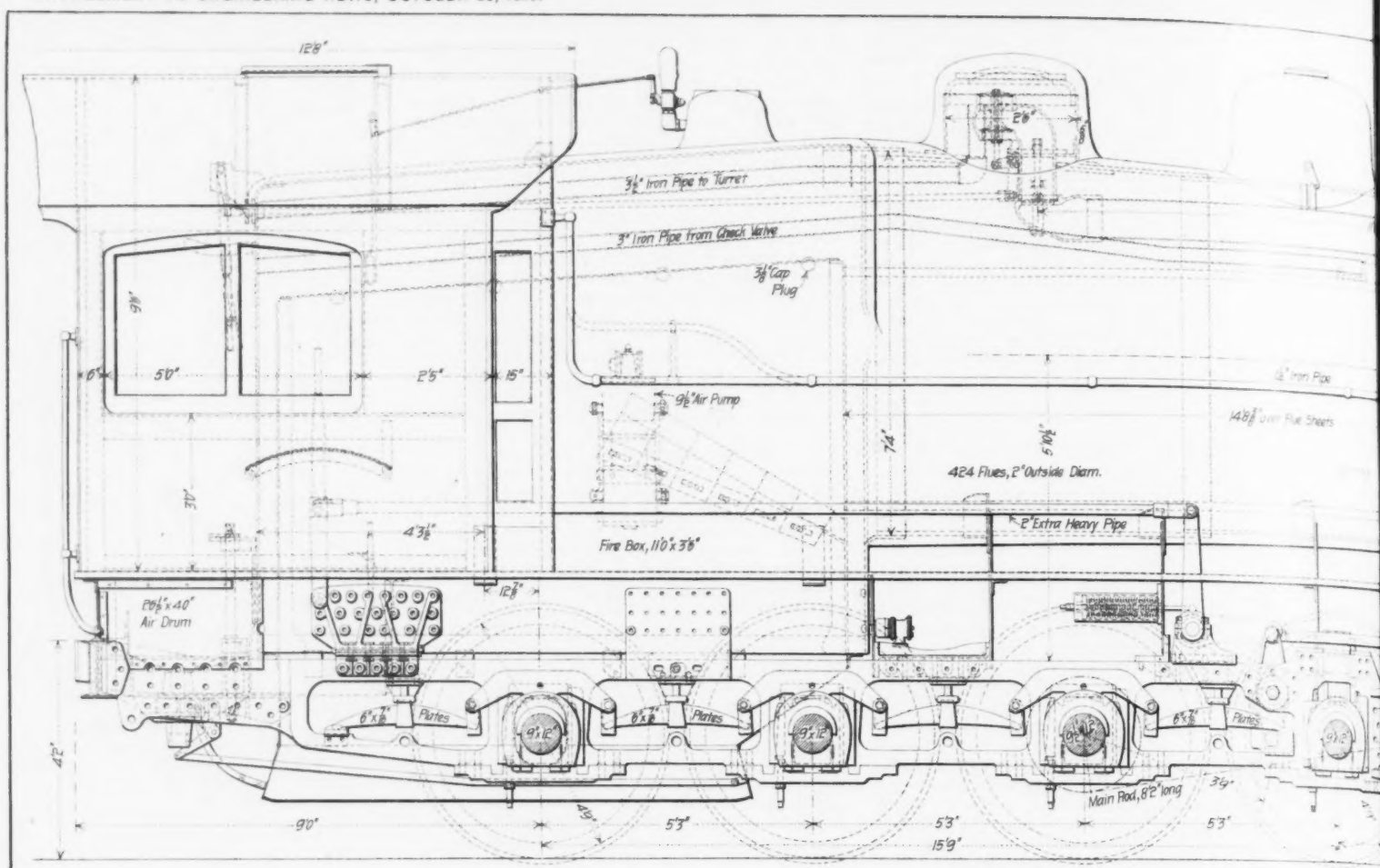
The huge locomotive for the Illinois Central R. R., which is illustrated on our inset sheet this week, is the largest and most powerful locomotive that has ever been built, eclipsing even the monster engines built last year for the Union R. R., of Pittsburg. In another column we have described the mechanical details of this huge machine; we propose here to consider its relation to the problem of the cheap transportation of bulk freights.

It is a fact of no small interest that the road which now breaks the record in large locomotives is not one of the Trunk line roads, which haul the products of the West to the Atlantic seaboard. This newest huge locomotive is built for the express purpose of hauling these products to market by a shorter and cheaper route, which avoids both the climb over the Alleghenies and the long detour to the north by way of Lake Erie and the Mohawk and Hudson valleys. It is built to haul solid trains carrying 2,000 tons of paying load over the division of the Illinois Central R. R., between Carbondale, Ill., and Fulton, Ky., which forms part of that company's through line from St. Louis and central Illinois to the terminals, where ocean steamers lie alongside at New Orleans. Surely the fact that such huge locomotives and heavy trains are deemed necessary for the economical movement of traffic on this road is a highly interesting indication of the volume of traffic which is already flowing in this direction, and of the probability that this competition of the Gulf ports with those on the Atlantic, and of the railways which reach the Gulf ports with the Trunk line roads, is destined to increase.

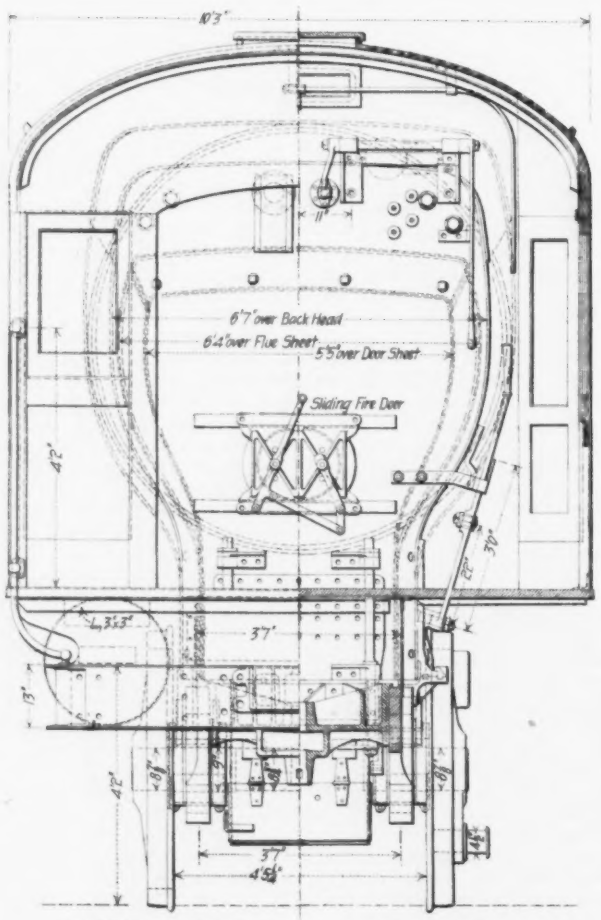
We have frequently pointed out to our readers how the steady growth in the power of locomotives and the weight of trains has reduced the cost of moving freight by rail. The first triumph of the locomotive was as a carrier of passenger traffic. There were railway managers in the early days of the railway era who contended that only high-class freight could be economically hauled by rail. To this day, in England and on the continent of Europe the inland waterways are able to carry freight as cheaply or more cheaply than competing railway lines. American railways, however, have developed far beyond those of any other country, and American railway managers have proved to the world that with the steel rail for a roadway, and steam for a motive power, freight can be moved far more cheaply than in any artificial waterway or river channel. The modern American freight train is in fact excelled only by the vessels on the Great Lakes and on the ocean as an economical machine for the transport of bulk freight.

Unfortunately this fact is not as yet clearly understood, save by the few who are conversant with recent progress in the railway field. It will probably surprise many engineers even to learn that this new Illinois Central locomotive is more than twice as powerful as the largest locomotives of fifteen years ago. The fact is that railroading back in the '70's and European railroad practice even at the present day is toy railroading in comparison with the work now being done on American railways of heavy traffic.

We have recently presented facts as to the very low rates which have been charged for bulk

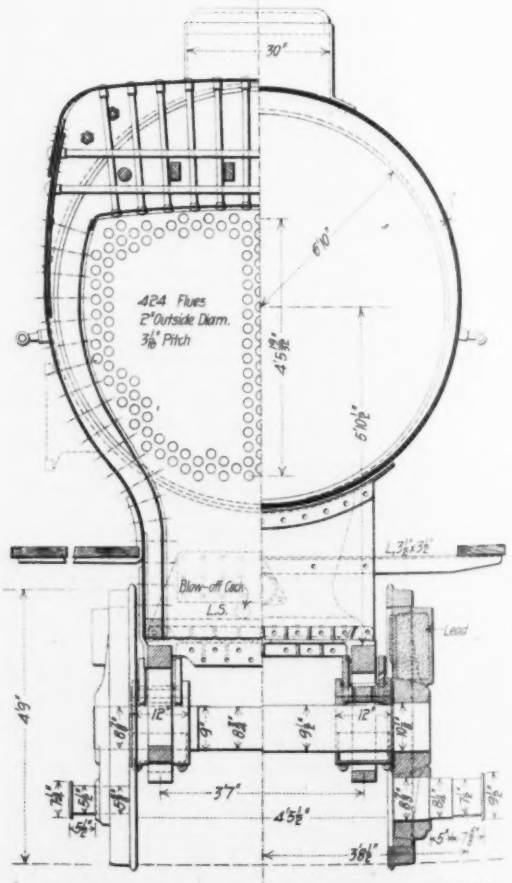


SECTIONAL SIDE ELEVATION.



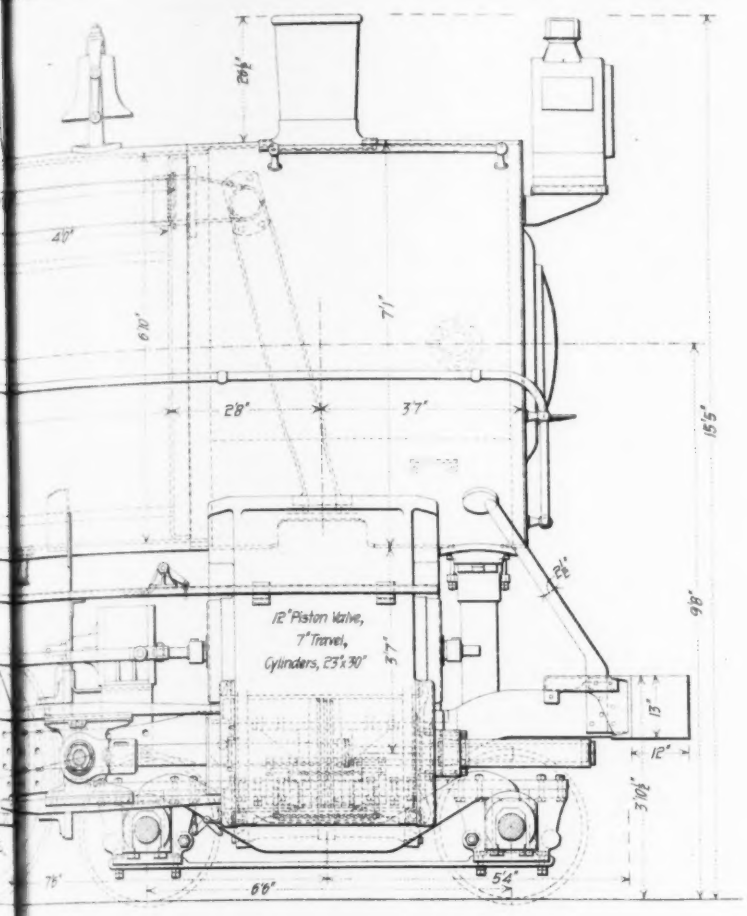
½ REAR ELEVATION.

½ TRANSV. SECTION THROUGH CAB.

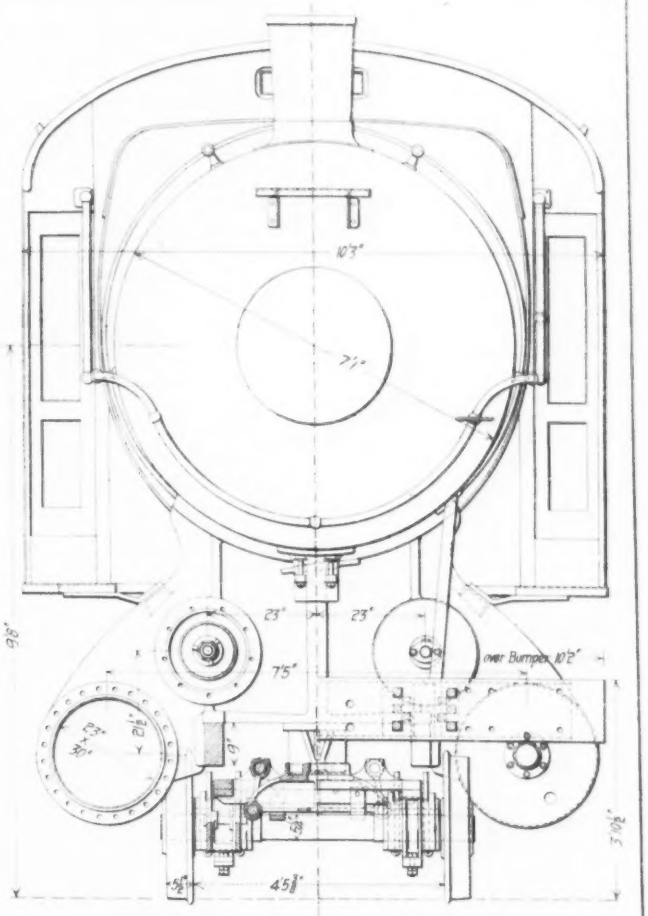


½ TRANSV. SECTION THROUGH FIREBOX.

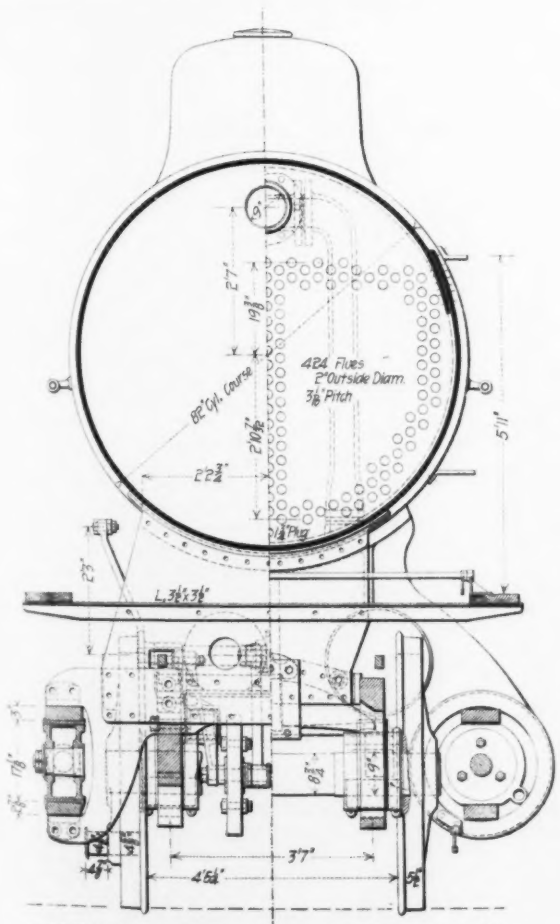
½ TRANSV. SECTION THROUGH MAIN DRIVER.



⅛ TRANSV. SECTION AT TRUCK CENTER.



⅛ FRONT ELEVATION.



⅛ TRANSV. SECTION THROUGH CROSS-HEAD.

⅛ TRANSV. SECTION AT FRONT DRIVER.

TWELVE WHEEL FREIGHT LOCOMOTIVE,

ILLINOIS CENTRAL R. R.

Brooks Locomotive Works, Builders.

CHAS. HART, LITH., 99 VESEY ST., N. Y.

freights on some American railways. In our issue of Aug. 17, we showed, for example, that the average rate of the Chesapeake & Ohio R. R. for all coal shipped to the seaboard in the year ending June 30, 1899, averaged only 2.21 mills per ton-mile. It is sometimes argued, however, that these rates really represent business carried at a loss. It is said that railways carry at less than cost traffic of this class, and make both ends meet by charging exorbitant rates on high-class merchandise. It is our belief that this is far from being the case, and that the most profitable business which the railway can handle, provided only that it is obtainable in sufficiently great volume, is the movement of through bulk freights in the heaviest possible train loads. The cost of handling traffic of this class can be very closely ascertained, and the profit upon it can, therefore, be accurately known, while the cost of handling small shipments of high-class goods is made up of such a multiplicity of items that only an approximate idea of its total amount can ever be reached.

As we have remarked above, this new Illinois Central locomotive is designed to handle trains carrying 2,000 tons of paying load. The movement of such trains is by no means experimental or doubtful. It may be of interest to note what one or two other railways of heavy traffic are accomplishing in the movement of heavy trains.

The Pittsburg, Bessemer & Lake Erie R. R., as many of our readers will recall, is a railway which was completed a couple of years ago to carry iron ore from Lake Erie to the Carnegie furnaces, near Pittsburg, at the lowest possible cost. Through the courtesy of Mr. J. S. Matson, Superintendent of freight transportation on this road, we are enabled to give the following figures of freight movement over this line during the present season. Up to August 24 last the *average* load of full trains hauled from the Lake to Pittsburg over this road since navigation opened was 1,644 net tons, or, including the weight of the cars themselves, a train weighing 2,137 tons behind the tender. The total distance is 145 miles, and the average time from terminal to terminal is 15 hours, making the average running speed 10 miles per hour. The average freight rate received by this road in 1898 was 4.1 mills per ton-mile. It is to be noted that the cost of hauling freight on this road is increased by the fact that the traffic is almost wholly in one direction and the length of haul is comparatively short, making the terminal expenses a large proportion of the total.

Let us take next the New York Central & Hudson River R. R. For the year ending June 30, 1899, the average paying load of all through freight trains, east and west, on the main line of this system, was 750 tons. The annual report states:

> The introduction of 28 new mogul locomotives, each capable of hauling 80 loaded 30-ton grain cars (making a gross weight of 3,600 tons for the train and its load, or 2,400 tons of paying load), has resulted in a saving of 505,114 train miles, or 3¼% decrease, although the volume of freight traffic was 8¼%. 20 additional locomotives of the same type were ordered toward the close of the year.

In view of the above statements, there is no reason to doubt that a train load of 2,000 tons may soon be the standard on low grade railways handling a large volume of through traffic. Now let us make some estimate of the actual cost to a railway company of moving bulk freight over long distances in 2,000-ton train loads. We may estimate the locomotive expenses per train-mile, for a locomotive capable of hauling a 2,000-ton train, to be about as follows:

	Cts. per train mile.
Fuel	15
Locomotive repairs	08
Water, oil, waste, etc.	03
Engine crew, wipers, etc.	10
Interest and depreciation on locomotive	04
Total	40

The load behind the locomotive may be carried in 66 cars of 30 tons' capacity each, and the cost of this rolling stock may be liberally estimated at ½-ct. per car mile, or 33 cts. per train mile, making, with the train crew at 10 cts., and train supplies at 7 cts., a total of 85 cts. per train mile for the expenses which vary directly with the volume of traffic.

The expense of station and signal service will be largely independent of the volume of traffic; but guided by the figures for such service on roads carrying a heavy traffic, we may assume 12 cts. per train mile as an ample figure, increasing the total to 97 cts.

It is next in order to consider what addition should be made to this to include the cost of the empty car movement in the reverse direction. We believe it will be liberal to allow one-half the sums above found, excluding the car rental charge (as rental is not paid on empty car movement). This will increase our total by 32 cts., and it now amounts to $1.29 per train mile.

We have now all the cost of moving freight over the road, with the exception of: (a) general office expenses; (b) maintenance of way and structures; (c) interest on the investment in the road and its equipment, exclusive of rolling stock, which has already been included; and (d), expenses at terminals. The first of these (general expenses) is so trifling on roads of heavy traffic that it may be omitted entirely without material error. The cost per train mile for maintenance of way and for interest on cost of road depend so directly on the volume of traffic that a word as to this must precede further estimate:

Not the least of the benefits of increasing the size of trains on railways is the increase which it gives in the traffic capacity of the line. Suppose that a railway moves one 2,000-ton train over its line one way every day for 300 days in the year. This leaves an ample margin for interruption of traffic by Sundays, holidays, accidents, etc., and yet such a train movement in only one direction represents the carriage of 600,000 tons of freight per annum. It is apparent from this that a double-track railway operated for freight traffic only has almost unlimited capacity for the movement of freight. Practically, the limit is set by the available rolling stock and the capacity of the terminals, not by any limit to the movement of trains on the road itself. A traffic of 10,000,000 tons per annum, assuming the traffic to be three-fourths in one direction, means only a movement of a dozen 2,000-ton loaded trains over the road in one direction daily for 300 days in the year.

So heavy a traffic as this, however, can be obtained by very few railways. For the purposes of our computation, therefore, we will assume a through freight movement of only 5,000,000 tons per annum. Taking the cost of the road (aside from its terminals) at $50,000 per mile, the interest charges at 4% will amount to $2,000 per mile per annum, and an additional $2,000 per mile is a fair estimate of the annual cost of the maintenance of way and structures per mile. Now, as 5,000,000 tons of freight passes over this mile of road, the charges per ton-mile for interest and maintenance of way will be $4,000, divided by 5,000,000, or ⅘ of a mill, or for a train load of 2,000 tons, a charge of 80 cts. It will be noticed that we have placed the whole charge for these two items upon the through freight, whereas on any road with no greater volume of through traffic than we have assumed, a considerable traffic of local freight and passengers could be carried, and would bear part of the expense for maintenance of way and of the interest charges. On this account it is fair to reduce somewhat the above figure of 80 cts. per train mile, but to be on the safe side we will only reduce it enough to make even figures, as shown in the following summary:

Estimate of total cost of movement of long-haul freight in 2,000-ton train loads (excluding terminal expenses):

	Cts. per train mile.
Locomotive expenses	40
Car rentals and train expenses	45
Stations, station service, signals, etc.	12
Add 50% for empty car movement (excluding car rentals)	32
Maintenance of way and structures	35½
Interest on cost of road	35½
Total	200

In other words, according to the above estimate, it is possible to move bulk freight by rail on low grade roads, if a large traffic can be secured, at a total cost of one mill per ton-mile, and this cost, it will be noted, includes the interest on the cost of the railway and rolling stock.

It will be understood, of course, that such low costs as are contemplated in the above estimate would be possible only under the conditions assumed, and the chief condition is the necessary volume of traffic. Were this assured them, we believe there are not a few railways which are prepared to move freight at a total expense of not more than one mill per ton-mile.

We have omitted entirely the matter of terminal charges in the above estimate for the reason that to include them is always misleading in any computations based on the ton-mile rate. Moreover, in comparing rail and water transportation, it must be remembered that each alike are subject to terminal charges, and local circumstances will determine whether the one or the other will have the larger expense for this. In general it can be said that terminals for railways are in general cheaper than those for waterways. Water front improvements are of necessity expensive, both in first cost and cost of improvements, while rail freight can be delivered wherever a spur track can be run. Rail traffic has made possible the building of great commercial centers entirely remote from waterways, a thing unknown in the old world; and the victory of railways over waterways is of transcendent importance to every such trade center in its competitions with its rivals.

There has been, during the past few weeks, an epidemic of commercial congresses. At Utica, at Philadelphia, and at Peoria, there have been gatherings which have wound up with formal resolutions in favor of large expenditures of state or national funds on the improvement of waterways. The South is following the example with waterway congresses soon to be held at Monroe, La., and Brenham, Tex. We do not question the sincerity and good faith of those who plead for more Government expenditures on the improvement of interior waterways, but they are certainly mistaken as to the real interests of the public.

We have shown above that the railway can carry freight at less cost than any inland waterway, river or canal. The attempts to revive water transportation in the face of rail competition are doomed, therefore, to only a temporary success at best. In the end the law of the "survival of the fittest" will prevail, and it will never be the steel roadway that will be given up. On the contrary, we have directly before us in our old time canals, the last of which are now being abandoned, practical evidence of the railway's economic superiority.

The last argument of the defender of the waterways, however, is that these must be kept open in order that their competition may keep railway charges down to a reasonable figure. We are told again and again of the influence which the Erie Canal has exerted in the past as a regulator of railway tariffs, and it is said that it would be profitable for the public to keep natural and artificial waterways open, even if not a pound of freight were carried upon them, merely for the sake of their influence in lowering railway rates.

Such a policy, however, would be extremely short-sighted. The railways have passed the point where the competition of any artificial waterway is of serious moment to them; and that an abandoned waterway, with no boats moving upon it, could have any serious influence upon railway rates is a proposition absurd upon its face.

Besides this, however, it is, as a matter of fact, against the public interest that traffic should be diverted from the railways. The right of the Government to fix and regulate railway rates has been fully established, and the principle that such rates should not be in excess of what is necessary to pay the operating expenses, and a fair return on the capital invested, has also been plainly laid down in court decisions. The proper method to regulate railway rates, therefore, is not by trying to create competition, either by building parallel railway lines or inferior water routes, but by the direct exercise of Government control. With this effected it will be for the direct interest of the public, as well as the railway owner, to preserve and increase the volume of traffic moved by rail. Diversion of traffic to waterways under these circumstances, means higher rates for freight moved by rail, since the cost of maintenance of way and fixed charges has to be borne by a smaller volume of traffic.

Finally, and with direct reference to the question as to the best policy for the State of New York to pursue toward the Erie Canal, we would point out that it is to the railways and not to the canal that New York must look for the preserva-

tion of its export trade. Such huge machines as this new Illinois Central locomotive can carry export traffic to ports on the Gulf more cheaply than it can reach New York through any artificial waterway. The railways which terminate at the ports on Chesapeake Bay can deliver grain there more cheaply than it can be carried to New York by any canal. The new Canadian water routes to the seaboard are also superior to any waterway which New York is in any way likely to build.

We are aware that the potential competition from all these sources is being used as an argument for pouring out additional millions of the state's money upon the canals. Properly interpreted, however, it is an argument for just the contrary course. The competition of these other routes will compel the railways reaching New York to keep their rates down in order to retain their traffic. It is this competition, and not that of any canal, which the New York Central is preparing to meet with its new locomotives capable of hauling 2,400-ton train loads. If New York would retain its position in the export trade, it must concentrate its energies upon the question of reducing the cost of handling freight at its terminals, so that it may bear comparison with the cost at the terminals built on cheap land at Newport News and New Orleans, and other competing Atlantic and Gulf ports. Money spent in this direction may bring returns; but that spent on artificial waterways is poured into a sieve.

CONCERNING SOME RECENT PROSPECTUSES.

The Scott-Janney Electric Co. was recently incorporated in New Jersey, with a capitalization of $30,000,000, and we have been favored with a copy of the company's prospectus, and an invitation to subscribe. According to this document, the company has been organized to manufacture electric apparatus under patents granted to Gordon J. Scott. The prospectus gives suggestive hints of the many wonderful things which are to be accomplished by means of the inventions of Mr. Scott, as well as a few items of information of an engineering nature which deserve to be put on record.

At the outset we are told—what many engineers will be pleased to learn—that, in electric railway practice, "there is no greater difficulty to be met in insulation for 2,000 volts than for 500 volts," and further, that "the voltage may be worked higher than 2,000 if necessary, with direct-current apparatus, and it is a perfectly feasible and practical thing to operate both generators and motors for heavy trunk line service at 10,000 to 15,000 volts."

Further on we are informed that this company has a controller which "will save from 30 to 50% of the energy now used to propel the cars," and also that, by combining this controller with the motors now in use "20 to 30% less current will be needed per car." This is certainly interesting, and we only wish the prospectus writer would handle his figures more carefully. It jars our faith to suspect that "20 to 30%" and "30 to 50%" sound just alike to him.

Again we learn that "a train of the heaviest character, equipped with this appliance, can be stopped within its own length . . . . from its maximum rate of speed," while further on we are told that speeds reaching 100 miles per hour are possible with this system. Putting these two statements together, the prospect which opens before future passengers by this system is truly exciting. We only hope for an invitation to be present—as a spectator, not as a passenger—when the first Scott-Janney train with the Scott-Janney brake is stopped within its own length (and we stipulate for a short train) from a speed of 100 miles per hour.

There are other gems in this prospectus; but we may not stop for more than a mere mention. We are introduced to a "gaso-electric system" (whatever that may be), which, "being entirely new, possesses advantages over all other systems of propulsion, as a power for automobiles, heavy trucks and carriages of every description." We trust that the Scott-Janney $30,000,000 aggregation is not infringing on the ideas of previous inventors who have tried to build central stations on wheels; but until further information is obtainable as to the nature of the gaso-electric system we shall have fears on this point.

A representative of this journal called, on Oct. 13, at the office of one of the brokers where subscription books to the company's stock were announced to be opened, in quest of further information. A director of the company confessed his ignorance of the technical points involved, and said he was a member of the stock exchange and had taken up this company as a "side issue." The subscription books were still open, although it was announced in the prospectus that they would be closed a week earlier. Apparently the public appetite for the company's stock became appeased before the $30,000,000 was all gone!

Another company which has recently received some notice in the newspapers is the United States Steel Co., incorporated in West Virginia, with a capital stock of $3,000,000. This company has been formed to convert steel scrap into what it calls "Jupiter steel." The prospectus states:

> The processes controlled by this company convert this scrap into steel, not only of its original value per lb., but also in any desired shape, thus saving cost of machining or drop forging. The scrap is melted in crucibles, a process that destroys most of the valuable steel properties, but at a fixed point in the melting certain ingredients are dropped into the molten mass that restore the valuable properties. The resulting product has every quality of the best steel.

Evidently the prospectus has reference to tool steel, for no process involving remelting in crucibles could turn out a product in competition with the open-hearth or Bessemer furnaces. As for remelting scrap tool steel and casting it in any desired shape "without machinery or forging," it appears to us that scrap tool steel of uniform composition is hardly to be obtained in the market. In case it could be secured, remelting in crucibles will secure excellent results without any "secret ingredients," and to talk of casting tool steel in competition with drop forging does not increase an engineer's confidence in the enterprise.

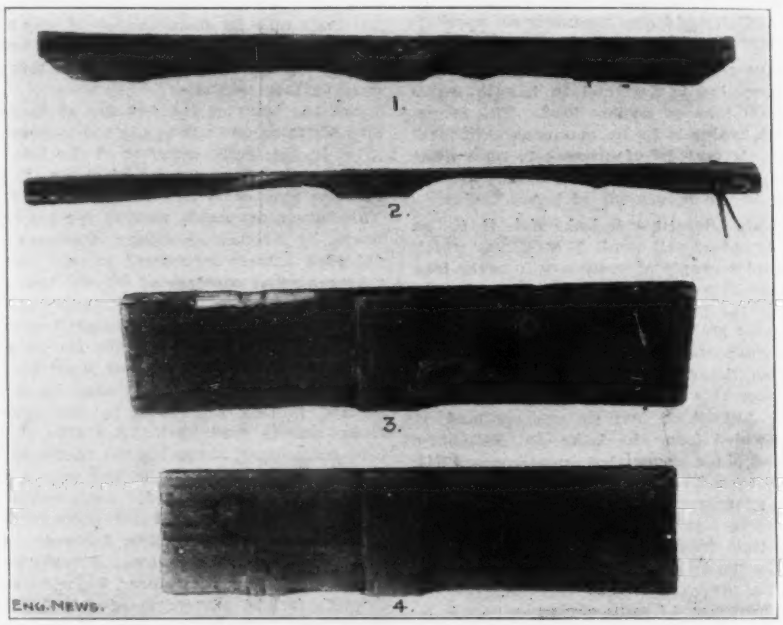
A third concern whose stock can be had for a consideration is the Thomas A. Edison, Jr., and William Holzer Steel & Iron Process Co., capitalized at $1,000,000. According to its advertisement, this company owns "valuable rights for the treatment of steel and other metals, which surpass the Krupp or Harvey systems in the preparation of steel for armor plates, steel structure, etc., out of which vast fortunes have been made." To a representative of Engineering News it was stated that the process was as yet secret, and some results of tests of steel alleged to be treated by the new process were shown, which indicated a material comparable with nickel steel and other high grade steel.

"Secret processes" of steel treatment are as o as Tubal Cain. Mr. Edison, Jr. and Mr. Holzer ma have a valuable secret; but until they protect it b patents, and make it known to those competen to judge of its merits or demerits, they can hard receive the serious attention of investors.

LETTERS TO THE EDITOR.

The Erosion of a Plank Bridge Floor by the Blast fro Locomotives Passing Underneath.

Sir: In repairing a city bridge, which crosses the ra way tracks near the mouth of the tunnel, in this city, had occasion, about two weeks ago, to take up the sid walk planking. The manner in which the underside the planks had been eroded by the smoke of the locomo tives seemed to me so instructive in regard to what is be expected of the wooden ceilings for the protection



FIGS. 1 TO 4.—SHOWING EROSION OF UNDER SIDE OF BRIDGE FLOORING PLANKS BY THE BLAST FROM LOCOMOTIVES PASSING UNDERNEATH.

our steel viaducts, which have of late been discussed in Engineering News, that I had four of the planks photographed, prints of which I enclose. Figs. 1 and 2 show the planks from the side, and Figs. 3 and 4 show their bottoms.

The 2-in. white pine sidewalk planking was laid four years ago at an elevation of 18 ft. above the rails, and the planks are now worn, from underneath, down to a thickness of ¾-in., and in some places to ½-in. even; while over the bearings the thickness is scarcely reduced. The greater resistance of hard spots, as at or near knots, is finely presented. In your article of Aug. 24, on wooden ceilings for the protection of structural work you say, that you should be glad to receive more information from those who have applied wooden ceilings of this sort, as to the method by which they are finished—whether painted or left bare. I consider the condition of the sidewalk planks shown on photograph a proof that the question of painting or whitewashing such ceilings is rather an idle one, and that the ceiling planks should be of considerable thickness, and at the worst places protected by galvanized iron or copper sheathing. Yours truly,

Carl Gayler, M. Am. Soc. C.E.,
Bridge Engineer, Street Department.

St. Louis, Mo., Oct. 18, 1899.

Air Cushions For Elevator Shafts in High Buildings.

Sir: I presume you are anxious to preserve strict accuracy in giving your readers information, and hence I take the liberty to make one or two corrections of statements in your article on Mr. Griffin's safety device for elevators contained in your issue of Oct. 19.

The section on the air-cushion states correctly that it "effects just this very desirable easy and steady stop," but it implies, that air-cushions, though formerly much used, have been superseded, as in the language of the article "they are evidently unsuitable for modern high lifts," and "unless a very deep shaft was made for the air-cushion, the stop would be highly disastrous to the passengers." Now, so far from becoming obsolete, the facts are, that the air-cushion is being applied to more elevators at present than ever before; that it has been adopted by the U. S. Government; that it has been in-

stalled and is now under installation in a number of buildings over 14 stories high—the list including 55 elevators over 10 stories high—and in at least one of these buildings (the Empire) a car has been dropped the full 20 stories in height without damage to the most fragile articles (eggs, glasses with water, etc.). It is, as you say, true that the air-cushion must be made proportionately deep (it includes the first and second stories in the above-mentioned building), and it would be the height of absurdity to construct an air-cushion for a 20-story building of no greater depth than for a 5-story one.

Facts and results are superior to theories and ingenious devices on paper, and the numerous drops that have been made into the air-cushion, always from a number of stories in height, have invariably been perfectly successful, and in many cases the car had living freight.

I trust that you will give utterance to this correction, as your paper, with its wide circulation among the mechanical and engineering interests of the country, is looked upon as high authority, and hence should strive for the greatest accuracy of statement, since its words have a weight that the greatest daily journal, however extensive its circulation, would not have.

Yours truly,

Edward B. Chestresmith,

Const. Engr. Ellithorpe Safety Air-Cushion Co.

71 Broadway, New York, Oct. 23, 1899.

Contract Work from a Contractor's Standpoint.

Sir: I desire to present through your valuable paper a few facts regarding the position in which contractors find themselves in these days of prosperity, and I believe the subject is of no small interest to engineers, as well as contractors.

Competition is said to be the life of trade, and the saying is true when the standard of prices is proportioned to the price of the materials and labor; but when competitors ignore the market by underbidding each other to such an extent that the price bid is below the value of the materials and labor, etc., required for the work, we find that competition results in the ruin of those who thus demoralize prices, or else there is faulty construction or abandonment of the contract. Such is the state of affairs that confronts contractors at the present time.

In their effort to secure high-class work, engineers go to extremes, and embody in their specifications requirements which it is next to impossible for a contractor to fulfill at the price for which he undertakes to do the work.

If affairs continue in this state, it will ultimately be necessary for municipalities and corporations to perform their work by day labor, for responsible contractors, who will do honest and thorough work, cannot be secured. The prospect for good times is over, for the good times are here! Why not avail ourselves of them?

Labor is scarce and wages have risen from $1.25 to $1.50 per day for common laborers, and other grades in proportion; yet, in nine cases out of ten, contracts are taken at cost, and the bidder trusts to good luck to come out whole! Compare the prices named by the lowest bidders with the prices of material and labor, and you will readily see that in nearly every case my contentions are correct.

I heard a laborer remark the other day, when the timekeeper went along the work to take the time, as he asked him what was his number: "What is the use of telling you my number? It's three months now that I am working and have got no pay, it's no use putting down my number." Another laborer, working for another contractor, remarked: "The first month we used to get our pay on the 15th, then the date was changed to the 20th, and now we are lucky if the paymaster gets around on the 25th."

This state of affairs among contractors is not due to stringency in the money market. It is because competition is overdone. The question presents itself, what is the remedy? Every contractor knows and needs no explanation.

Yours truly, D. Cuozzo.

39 Sherman St., Brooklyn, N. Y., Oct. 16, 1899.

The Septic Tank Process of Sewage Treatment at Exeter and Yeovil, England.

Sir: Although the literature of sewage purification and disposal has been growing at a rapid rate in the past decade, the experiments and studies of the Massachusetts State Board of Health, supplemented by those of individual engineers, chemists and bacteriologists in Europe and America, keep the subject ever a prominent and interesting one for not only the professions directly concerned in its discussion, but also for municipal governing bodies and so much of the general public as may be intelligently interested in the sanitary improvement of the towns and cities in which they are obliged to spend the larger part of their lives.

In modern works of sanitation, England undoubtedly took the initiative, and in no other part of the civilized world at the present day is more time, study and discussion being devoted to sanitary reform. I think that possibly this statement may be modified for the benefit of the one state of Massachusetts, whose liberal appropriations of money and the intelligent investigations of whose specialists, have placed it in the very front rank as an authority in sanitary matters.

The city of Exeter, capital of the rich and beautiful county of Devon, has the unique distinction of being the most continuously occupied city in all England; human habitation of its site since earliest known records has never ceased; the official record of its government is unbroken for over 600 years, and for more than a decade before London had a Lord Mayor, the privilege of Mayoralty was granted by royal charter to Exeter in the year 1200; in the ancient Guildhall, where the names of the Mayors have been printed in colors on the walls, the City Surveyor proudly pointed out to me the name and date of the first incumbent of the office.

In the seventeenth century Exeter is described by a quaint writer as "sited on a top of a hill which conduceth much to the cleanness of this city, nature being the chief scavenger thereto, so that the rain that falleth there falleth thence by the declivity of the place." With such a testimonial elicited so early in its history, Exeter could not afford to "take a back seat" in sanitary matters; we need not be surprised therefore to learn that Exeter was the first city in Great Britain to adopt a regular system of sewerage—some of the original sewers are still in use, and are interesting examples of early sanitary engineering. But through all these centuries of human occupation, from the days of the Celtic hill-fort and the Roman city to the present time, the River Exe has carried away and purified its sewage, yet Exeter is not happy, because the government of Great Britain is a crank on sewage purification, and demands a certain standard of purity of sewage before it may be turned into streams, whether the water of these streams is to be used for domestic consumption or not. On account of the vast manufacturing establishments, and the growth of cities and towns, the diminutive waterways of Great Britain were rapidly becoming simply open sewers, with every prospect of an aggravated condition being made worse, it was not practicable to draw the line where pollution should be allowed in the interest of trade, or prevented in the interest of general health and comfort.

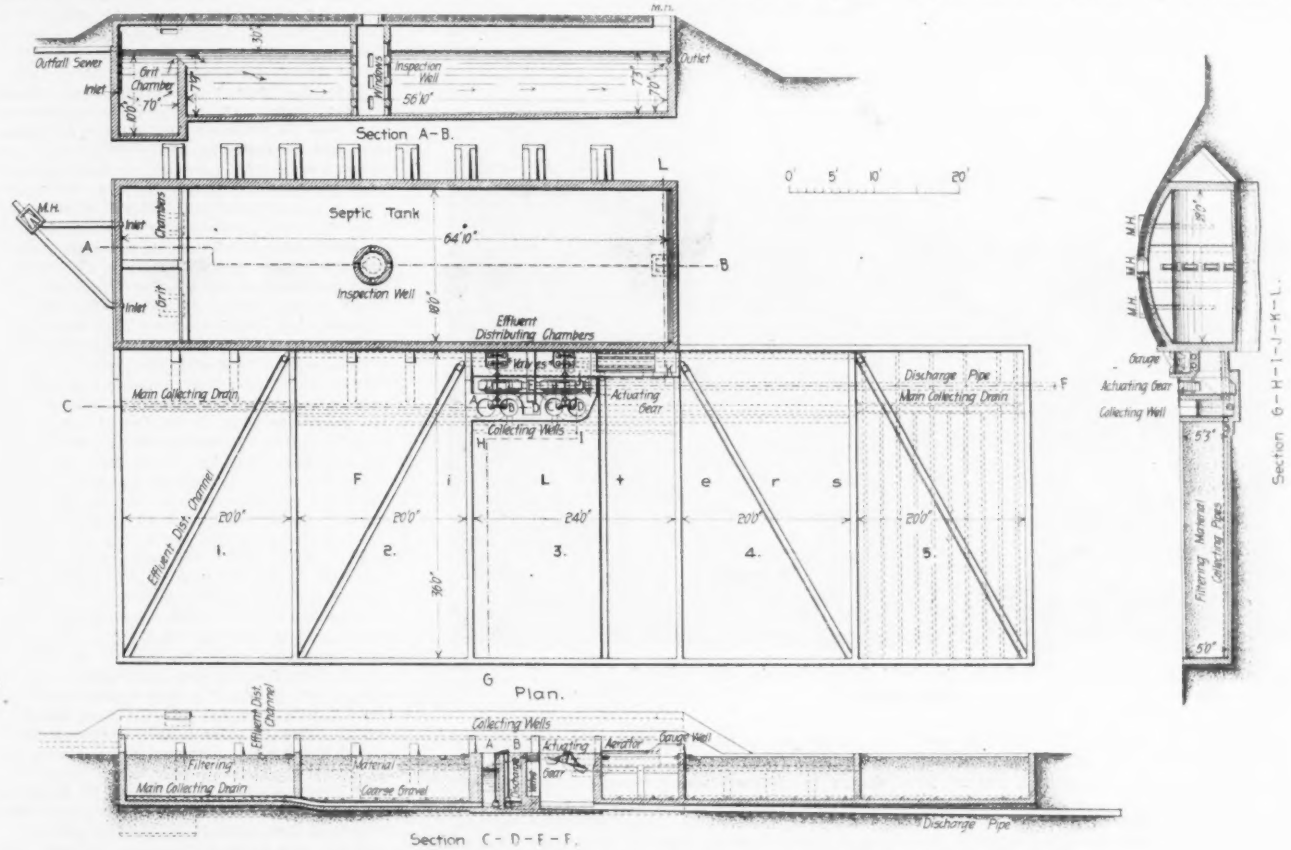


FIG. 1.—PLAN AND SECTION OF SEPTIC TANK AND FILTER BEDS AT EXETER, ENG.
Cameron, Commin & Martin, Patentees and Engineers, Exeter and Westminster, England.

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suggested from New York that I run down to Exeter and see the working of this latest triumph of sanitary science, it tallied exactly with my inclination.

Exeter is 171 miles from London by the line of the London & South-Western Railway, and the schedule time for the run of the fast express is 3 h. 46 m.; the first-class fare is $6.84, or exactly four cents per mile; the third-class fare is just one-half; the first stop after leaving Waterloo Station is at Salisbury—84 miles distance. Only one more stop—at Sherburne—is made before reaching Exeter. The roadbed is considered one of the best in England, but at high speeds the sway of the coaches was very pronounced. On account of the thin and low roof, the English railway coach in ordinary warm weather is a very warm place, except directly in the strong draft through the door windows while the train is in motion.

The office of an English City Surveyor in the early forenoon is usually a busy place; the City Surveyor has to look after the entire physical condition of the city, and not only sewers, water-works, street lighting, streets, etc., etc., must receive his attention, but there are duties peculiar to an English office unknown to an American city engineer. Probably the office in the United States most nearly paralleling an English one is that of Providence, R. I.

By arrangement with Mr. Cameron, I had deferred my visit until the City Council summer vacation had commenced on August 2; his own vacation had also commenced, so that he had his time more at his own disposal.

FIG. 2.—VIEW OF SEWAGE FILTER BEDS AND AUTOMATIC ALTERNATING GEAR AT EXETER, ENGLAND.

After a critical examination of drawings, assisted by Mr. Cameron's explanations, I was sent with a very clever office assistant—Mr. Wm. S. Eyles—to the filter beds at Belle Isle, St. Leonards, a drive of about one mile, leading through a handsome residential district.

The population of St. Leonards' District is about 1,500, and it is residential: the raw sewage, amounting in volume in dry weather to about 50,000 gallons per 24 hours, is quite free from the discharge of any manufacturing wastes; at about 400 ft. from the outlet at the river it is diverted towards the Septic Tank and filter beds, through which it passes before final discharge to the River Exe. Fig. 1 shows a plan and sections of the tank and filter beds. Fig. 2 is a view of the beds, showing also the automatic alternating device for turning the sewage from one bed to another.

The Exeter "Septic Tank" is a water-tight "cesspool," made of cemented masonry; it is 64 ft. 10 ins. long by 18 ft. wide, and from 7 to 10 ft. deep; its capacity is about 53,800 gallons. The raw sewage is seen in a small manhole just outside the tank, where also a grating intercepts any large piece of wood, a brickbat or similar cumbersome article; otherwise there is no screening; everything goes into the tank. But the sewage flows into the tank at the bottom, and a "grit chamber," 10 ft. deep and 7 ft. wide, there intercepts the mineral matter in suspension, which is deposited, while the lighter sewage rises to the top of a weir about 9 ft. high, and flows on through the tank at the rate of 2 ft. per hour, almost equivalent to standing still. Air and light are excluded from the tank, and the "process" now commences.

What is the "process"?

While engaged in business in New York city, for twelve years I was a resident of a small city in New Jersey, 25 miles distant from the Hudson. It was until a few years ago a "cesspool" community, there being not a single sewer for other than storm water in the six square miles of its area. The subsoil was especially well adapted for drainage and filtering purposes, being the bed of a glacial moraine, the material deposited graduating from bowlders to finest sand in a distance of three miles. Nearly every house had one or more "cesspools," the maximum depth allowable being 8 ft., although why that limit I cannot solve. When I commenced to live in a house which I bought and added to I had a new "cesspool" dug, and while the bottom was the gravel bed, the sides were a dry stone wall; the entire sewage of a family of six persons flowed into that single "cesspool" for seven years (although two years was the time allowed by the Board of Health), and I had it cleaned out then—not because it was full or offensive, but because I thought I must do it before I was compelled to. Like all properly-built cesspools, it was completely covered in and out of sight, except for a small vent pipe. The contents when taken out were scum and grease; the fluids had filtered off into the gravel and helped to replenish the wells for domestic water supply in the vicinity: what had become of the seven years' accumulation of sludge? But, as Rudyard Kipling frequently has said, that is another story!

Years ago I used to attend a good many conventions of water-works engineers and superintendents; at first the papers and discussions were of the most practical nature possible; then the better-educated civil engineer with his "book learning" and theories fired off an occasional paper, and finally the "learned professor" appeared at the increasingly important meetings, with "the paper" of the convention. At a meeting in the Grand Pacific Hotel, Chicago, many years ago, Professor Leeds read a long and important paper dealing with the causes of impurity of water supplies; it was listened to patiently by the hard-headed old water superintendents, but there was a pretty general expression among themselves afterward that "they wouldn't use much water in their's in the future" if it was such an infested compound as the learned professor had made it out to be. The words "bacteria and bacteriology" were hardly known at that time, and at present writing they are still terms of mystery to very many people who might be credited with being familiar with them.

The old-fashioned "cesspool" was the natural method of disposing of house sewage; it is, however, a crude device as ordinarily constructed; it cannot be used in a non-porous soil, or where the water does not filter away, and as a closed receptacle it is expensive to maintain. Besides, it is a source of defilement of the soil, and altogether it is an objectionable, and occasionally a dangerous, method of disposing of house wastes.

But Mr. Cameron has got close to nature, and his "Septic Tank" is a "glorified" cesspool, reduced to the service of man by the inventive skill of the civil engineer applied to the results of the studies and experiments of the chemist and bacteriologist.

The "Septic Tank" excludes air and light; motion is practically arrested; the bacteria have an undisturbed field in which to work; they multiply indefinitely and rapidly; "they first feed on organic matter, convert it into a simpler form, and then poison themselves by their own product. They give place to another race, which in its turn feeds and prospers on what their predecessors have left, till at last the solids of sewage are broken down by many operations and races of microbes following one upon the other with beneficent and wondrous rapidity. Instead of destroying micro-organisms, Mr. Cameron has sought to encourage their production to the utmost extent. This is the purpose of the 'Septic Tank.'"*

The result of all this is that there is practically no sludge; the present works at Belle Isle were first brought into use in August, 1896, and have not been disturbed since; an examination chamber is built in the center of the tank, through windows in which, and with lamp-holes on either side, the contents of the tank may be inspected. A scum about three inches thick rises to the top; this also disintegrates and is constantly being replaced.

The tank effluent flows through a pipe 18 ins. below the surface, and through a pipe laid outside the tank; it passes into a small trough with a sloping glass cover to admit light; it falls over a notched weir and into a lower trough, over the sides of which it again falls in a thin film; this is for aerating purposes on its way to the filter beds. I opened one part of this glass cover to take out a sample of the purified sewage; the effluent I have noted as "dusty," smell "slightly sulphurous;" the wall of the aerating trough showed a sulphur-colored deposition, which Mr. Cameron afterwards told me was a fungus growth; the "dusty" appearance of the effluent was of mineral origin, and it afterwards formed a very thin scale over the filters, so thin as not to be measurable, but yet could be seen; the effluent pipe from the tank was changed to outside purposely to intercept some of this "dust" and prevent it from going to the filters.

From the "aerator" the effluent flows on to the filter beds. The automatic-machinery by which the filter beds are filled and emptied is on the principle of the flush tank operated by the tipping bucket; so efficient is this automatic service that the labor or attendance is reduced to less than one hour a day, and that is for occasionally weeding a bed, lighting a lamp daily and extinguishing it, changing the plugs in valve chambers, and to keep the surroundings in a neat and tidy condition generally. The wage paid is five pence per hour, and about two hours daily is allowed because certain changings of valve chambers are so dependent on the flow of sewage that the time cannot be absolutely determined. I reached the filter beds just a few minutes before the discharge of one of the "collecting wells"—or flush tank, as I may designate it—and it was very interesting to note the turning of the shaft to which the tipping bucket was fastened, the opening of the valve to discharge one well and the closing of the valve of another well; then while the sewage on one filter bed began to sink through the coke and sink out of sight, another bed was rapidly covered with sewage from the aerating trough, the distributing channel of split sewer pipe diagonally crossing each bed facilitating its rapid and even distribution over the surface. A "collecting well" was discharged about once every hour.

There was no smell; a very sensitive individual—like a farmer's wife, who was accustomed all her life to only a reeking barnyard effluvia, for instance—might imagine a small laundry was in operation in the vicinity, but actually the odor from those five filter beds, all more or less saturated with sewage, was not appreciable to my olfactories, and I indulge in considerable conceit over the acute sensitiveness of these parts of my physical make up.

I would very much prefer to live alongside that sewage-disposal plant than beside a coal yard, a blacksmith shop, a livery stable or a rum shop, to say nothing of a cow stable, a pig pen, or even a cheap boarding house, all of which are tolerated in every community and against the annoyance of which there is no redress.

The gas generated in the septic tank supplies four incandescent (Welsbach) burners for lighting the near vicinity; there is not much light, but the heat is sufficient to make a gallon of water boil in 32 minutes; a small gasometer was formerly used to collect the gas and light a small office room; the gas is now led directly to the lamps, and it was lighted for my benefit.

Further conversation with Mr. Cameron, on my return to his office, coupled with reference to drawings, simply added to my better comprehension of the process.

The question of cost of construction must be considered in each individual case; I see no reason why it should be greater than the purchase and equipment of a process of simple downward intermittent filtration, and certainly it is preferable to a chemical precipitation plant, involving expensive machinery and large daily cost of maintenance.

The novel features of the Septic Tank process are

*The Lancet.

patented in a large number of countries, including, of course, the United States. The patentees are Messrs. Cameron, Commin and Martin, all civil engineers, with offices in Exeter and London, and an agent for the sale of right to use already established in Chicago, Ill.

From Exeter I returned to Yeovil (distant about an hour's ride on the L. & S. W. Ry. from Exeter), where an experimental Septic Tank system has been in operation since August, 1896, and which I wished to see, because, as distinguished from Exeter, the sewage of Yeovil is exceedingly foul, containing, as it does, a great amount of trade refuse from glove factories, tanneries and breweries. Mr. W. K. L. Armytage, Borough Surveyor, received me most courteously, and accompanied me to the experiment filter beds, which were surrounded by factories and dwellings, and close to the railway line, with the river between. The plant is smaller than that of Exeter, the capacity of the Septic Tank being about 21,000 gallons, and there being three filters only; the construction was almost identical with that of Exeter, with a slight modification of the automatic apparatus for discharging the collection wells. Manholes were opened by the employee in charge; a test rod was dropped into the Septic Tank to show thickness of scum, the color of sewage below, and the presence and composition of any accumulated sludge, the test rod terminating in a cup-shaped arrangement. There wasn't any sludge; not any that could be brought to the surface; there was scarcely any smell from the tank, and from the bottles of effluent, some of the contents being nearly three years old, no smell arose, and scarcely any sediment was visible; in some of recent date not any. The final effluent was all that could be desired. The sewage was passed through the tank in 24 hours; the daily consumption of water in Yeovil is 28 gallons per capita, a little less than that of Exeter.

Mr. Armytage expressed himself as unqualifiedly satisfied with the practical results of the process, and, as at Exeter, after years of experimenting under every possible condition, it was the intention of the borough to treat the entire volume of sewage by the same process.

The claims of the inventor of the Septic Tank System of Sewage Treatment are: Low cost in construction, small cost of maintenance, no sludge to remove, no chemicals used, and no offense to sight or smell given; judging from appearances, I believe that the claims are sustained by experience; this seems also to be the opinion of numerous municipal bodies in England, which have already constructed, or authorized construction of, similar plants on a much larger scale. Criticism will develop any weak points—the absolutely perfect system of sewage treatment is hardly yet discovered—but it is undoubtedly the nearest to perfection of any system yet exploited.

I beg leave again to acknowledge the kind courtesies of Messrs. Cameron and Martin, of Exeter, and of Mr. Armytage, of Yeovil.

I hope very soon to visit similar works at Manchester, Leeds and some other large cities, where the problem of treating the sewage of great manufacturing centers is one of paramount importance. G. H. F.

London, August 10, 1899.

(For previous articles on the Septic Tank Process, see the following issues of Engineering News: Jan. 13, May 12, July 7, Aug. 4, 1898; Feb. 2, June 8, July 13, Aug. 17, Sept. 7, 1899.—Ed.)

THE SMOKELESS POWDER, stored in magazines for the use of sea-coast guns, has been found to have deteriorated to such an extent as to be dangerous to use. A 10-in. gun was lately burst by this powder that had been stored two years, and the resulting examination showed that practically all the stored powder was affected. A change in formula is absolutely necessary, and the cause of deterioration is being investigated.

THE MARCONI WIRELESS TELEGRAPHY is to be tested for naval purposes, and the cruiser "New York" and battleship "Massachusetts" are being fitted up by Mr. Marconi for the test, with his headquarters on the "New York." If the experiments are satisfactory a land station will be established and tests made to determine the value of the apparatus in lighthouses, to warn approaching vessels of danger.

THE LEAGUE ISLAND DRY-DOCK CONTRACT, at Philadelphia, was awarded, on Oct. 23, to the Atlantic, Pacific & Gulf Construction Co., of New York city, as the lowest bidder. The same company holds the contract for the Mare Island dry-dock. While this award was made on the basis of a timber dock at League Island, it is hoped that Congress will appropriate an extra sum sufficient to build it of concrete and stone, as recommended by the Bureau of Yards and Docks.

THE "ORIENTAL" GRAVING-DOCK lately completed at Shanghai is described in "Engineering." The capacity of the dock is such that it has admitted the "Konigsberg," a vessel of 4,855 tons, having on board 2,500 tons of cargo, or imposing a total weight of about 7,000 tons on the blocks. This dock is 571 ft. long on top; 465 ft. long to the inner chase and 526 ft. to the outer caisson. The entrance width is 64 ft. at the bottom and 80 ft. at top, and the dock itself is 54 ft. wide on the bottom and 128 ft. at top. The depth of water on the sill is 23 to 24 ft. at ordinary spring tides. The caisson-gate is built of wood. The foundation was a troublesome muddy sand, and in this were driven 1,200 12 x 12-in. piles, 24 ft. long and 3 ft. apart on centers; these piles were capped by longitudinal stringers; braced by transverse stringers; bedded in 7 ft. of concrete and then covered with 3-in. planking. The keel-blocks, placed 4 ft. apart, had 6 additional closely-driven piles under them. At each gateway was a bulkhead of tongue and grooved piles, 12 ins. square and driven 20 ft. below the sill. The sides of the dock were made of heavy timbers, braced back and forming the altars. Two centrifugal pumps, 22 and 27-in. diameter, pump out the dock in 2½ hours. The dockyard contains a well-equipped machine shop and boiler shop, and steel sheer legs of 75 tons lifting capacity.

THE LIVERPOOL DREDGEBOATS "BRANCKER" and "G. B. Crow," according to the report of the Chief Engineer of the Mersey Dock & Harbor Board, during the fiscal year ending June 30, 1899, removed a total of 6,325,000 tons of sand from the Mersey Bar and Queen's and Crosby Channels, in the approach to Liverpool. Since operations commenced, in September, 1890, 22,768,240 tons of sand have been removed from the bar, and 19,508,870 tons from the shoals in the two channels named. The latest soundings over the whole area dredged show two spots of 27 ft. and a few of 28 ft., but there is a channel through the center with no sounding less than 29 ft. at low water of spring tides. These two dredges are of the sand-pump type, depositing the sand in bins on the vessels.

RIVER AND HARBOR ESTIMATES, for work to be done in the waters about New York, to be submitted to Congress by Secretary Root on the recommendation of General Wilson, Chief of Engineers, U. S. A., appear as follows: Expended in the last fiscal year, over $14,000,000; needed to continue existing contracts in the next fiscal year, over $15,000,000; and for the construction and maintenance of other approved work in this section, $26,000,000. Among the estimates for immediate expenditure in the territory contiguous to New York are the following:

East River and Hell Gate	$200,000	Staten Island Channel	$10,000
Harlem River	500,000	Elizabeth River	2,500
Newtown Creek	10,000	Raritan River	50,000
Canarsie Bay	15,000	South River	10,000
Brown's Creek, Sayville	10,000	Raritan Bay	65,375
Patchogue River	2,500	Matawan Creek	3,000
New York Harbor	100,000	Keyport Harbor	5,000
Bay Ridge Channel	332,000	Shoal Harbor	15,000
Gowanus Channel	20,000	Shrewsbury River, N. J.	10,000
Pt. Chester Harbor	5,000	Greenwich Harbor, Con.	14,000
Mamaroneck Harbor	11,000	Coscob and Mianus	10,000
Larchmont Harbor	20,000	Stamford Harbor	12,000
East Chester Creek	2,500	Five Mile River	5,000
Bronx River	25,000	Norwalk Harbor	15,000
Mattituck Harbor	25,000	Saugatuck River	5,000
Pt. Jefferson Harbor	33,000	Bridgeport Harbor	50,000
Huntington Harbor	2,500	Housatonic River	24,000
Flushing Bay	15,000	New Haven Breakwater	100,000
Peekskill Harbor	20,000	Harbor	50,000
Roudout Harbor	2,500	Connecticut River	20,000
Saugerties Harbor	2,500	Duck Island Harbor	25,000
Hudson River	400,000	Thames River	20,000
Narrows of Lake Champlain	17,500		
Passaic River, N. J.	20,000		

THE AMERICAN STEEL BARGE CO.'S fleet of ore-carriers has been purchased by J. D. Rockefeller, and is to be worked in connection with the Lake Superior Consolidated Iron Mines, controlled by Mr. Rockefeller. It is stated that the Carnegie-Oliver interests were also bidding for this fleet and offered $3,000,000 for it. As a result of their failure to secure it, the Pittsburg people have contracted with the American Shipbuilding Co. to build five lake steamers, 475 ft. long over all, and costing about $385,000 each. They will be the largest steamers on the lakes.

THE UPPER LAKE IRON DISTRICT is expected to turn out 20,000,000 tons of ore next year, according to the contracts made for delivery in the next season. The output was 16,000,000 tons this year. The dealers count that the advances in wages of the ore-handlers and increase in lake freights will make it necessary to advance the ore-selling rate about $2 per ton. The Rockefeller interests have leased mines with an output of 6,000,000 tons per year; and the Carnegie interests have increased their capacity from 1,500,000 to 4,500,000 tons, and are also building 8 large ore-transports.

VALUABLE MEXICAN COAL MINING CONCESSIONS have been secured by the Pacific Coast Coal Co., which is a Philadelphia corporation headed by Mr. William H. Ingham, of that city. Under the Mexican railway law of April 29, 1899, this company has secured a concession for building a railway from Guaymas to San Marcial, a distance of 100 miles. They intend to mine coal in the San Marcial Valley, State of Sonora, and convey it to Guaymas, on the Pacific coast. To this end they have secured all the coal rights and necessary water rights on 30,000 acres of land, says the "Coal Trade Journal," and the transfer of this property was made on June 2, 1899. The land is 750 ft. above the sea, and borings to a depth of 500 ft. show anthracite coal of a good quality. The franchise is for 99 years with an exemption from all Federal and State taxes for 15 years, and for 5 years from import duties on materials and supplies for the railway. One year is allowed for exploration and three years for construction. The contract carries a right of way 50 m., or about 230 ft. wide. At the present time coal costs from $15 to $20 per ton along this Pacific coast, though this price is probably in Mexican money.

THE COKE INDUSTRY OF THE UNITED STATES in 1898, says the U. S. Geological Survey, is credited with a total output of 16,047,209 short tons, with all but 660,824 tons coming from the Appalachian field. The product for 1898 was more than 20% in excess of any previous year; it was nearly 90% in excess of the product of 1888, and nearly five times that of 1880. There was a decline in value, however, with an average price of $1.09 per ton in 1898, as compared with $1.66 in 1897. The aggregate value of the coke product of 1898 was $25,586,669.

THE WORLD'S OUTPUT OF IRON ORE, says the "Iron and Coal Trades Review," has advanced from 58,354,476 tons, in 1890, to 72,159,393 tons in 1897, and about 78,000,000 tons in 1898; the estimated output for 1899 is 85,500,000 tons, with 13,000,000 tons of pig-iron attributed to the United States. Prof. Akerman, in recently reviewing the Swedish iron industry, for 1890-97, in a total of 72,159,393 tons of iron ore, credits the United States with 17,798,335 tons; Germany and Luxembourg with 15,465,979 tons; Great Britain and Ireland with 14,008,484 tons; Spain with 7,419,768 tons, and France with 4,582,250 tons. In the same estimate, for the output of pig-iron in 1897, we find the corresponding credits as follows: United States, 9,807,123 tons; Great Britain and Ireland, 8,937,205 tons; Germany and Luxembourg, 6,881,466 tons; Spain, only 147,000 tons, and France, 2,484,191 tons. In the two lists Russia figures with 4,023,778 tons of iron ore, and 1,835,647 tons of pig-iron.

NEW CHINESE MINING REGULATIONS were promulgated on July 30, 1899, according to a report to the Department of State by Minister Conger, of Pekin. In mining concessions, instead of the control remaining in the hands of Chinese merchants, as fixed by former regulations, Chinese and foreigners shall share alike, or half and half, in all new concessions. The direction, however, must remain in Chinese hands. In the future, when Chinese merchants apply to work mines, the local officials must investigate, but have no power to grant concessions. If the local officials agree, foreigners may be invited to take shares and a mining contract may be drawn up; but this contract must be approved by the government bureau before it is valid. No company can be formed for working mines before applying to the government bureau for authority. All enterprises formerly sanctioned by this bureau were to be commenced within six months of the date of sanction, "unless it could be shown that delay was unavoidable." This clause permitted fraud by introducing trivial delays, and the new regulations extend the time to ten months, but at the end of that time the contract will be canceled if work is not commenced.

OHIO COAL MINES are reported upon, for 1898, by Mr. R. M. Haseltine, Chief Inspector of Mines. This report shows that 9,270,568 tons were shipped by Lake transports, a gain of 1,273,320 tons over 1897. Of this amount for 1898, 3,058,528 tons were anthracite coal, and of the 6,212,040 tons of bituminous coal shipped 4,007,755 tons came from Pennsylvania mines; of the remainder, 1,380,956 tons came from Ohio mines and 823,329 tons from West Virginia. The total amount of coal mined in Ohio in 1898 was 14,058,135 tons, an increase of 1,609,313 tons over the preceding year. Of this total, 5,252,598 tons were machine-mined, with the lump coal averaging 78% of the total. During the year 79 new mines were opened; 100 were unworked, and 73 were abandoned; out of the 1,255 mines in the state, 425 are regarded as large mines, and 830 employ less than 10 men. In all, 29,365 miners were employed in 1898, a gain of 6,888 over 1897. The average yearly production per miner was 546 tons; and the scale rate for pick-mining was 56 cts. per ton to April 1, 1898, and 66 cts. to the close of that year; making an average of 62¼ cts. per ton. Each machine-runner averaged $2.45 per day, while the mines were in operation, or $419.83 per year. The men shooting down and loading coal averaged $1.39 per day, or $237.50 for a year's work. Powder returns show an average of 59⅝ tons of coal mined per keg of powder consumed; with a lowest output of 29 tons, and a largest of 148 tons.

THE LARGEST STEAM SUPERHEATING PLANT in the world has been installed at the works of the Aachen Mining Co., at Rothe Erde, Germany, according to "Annalen fur Gewerbe und Bauwesen" of May 1, 1899. All the boilers are provided with Schwoerer's superheaters, 42 of which have been installed in the flues connected with a similar number of Cornish double-flue boilers, having aggregate heating surfaces of 47,363 sq. ft. Besides these an additional set of five large superheaters of the same type have been connected with a second group of 24 Cornish boilers, with a heating area of 26,910 sq. ft. It is stated that very careful tests, extending over three years of day and night working, have shown the saving in fuel by the use of this plant to be from 15% to 20%.

THE GRAIN ELEVATOR PLANT AT DULUTH is growing very rapidly, and by next year will nearly equal that of Chicago in capacity. The present capacity of the Duluth elevators is 23,000,000 bushels, with 2,000,000 bushels mill-elevator capacity in addition. But there are also either under construction or planned two 5,000,000 bushel elevators, one 6,000,000 bushel elevator and one 1,000,000 bushel elevator. When these are completed the total elevator capacity at Duluth will be about 42,000,000 bushels. In 1898 the receipts at this point were as follows: Wheat, 68,509,000 bushels; oats, 5,145,000 bushels; corn, 3,626,000 bushels; rye, 3,206,000 bushels; flax, 7,317,000 lbs.; flour, 6,260,000 barrels. Up to August of this year these amounts were exceeded. These elevators are generally founded on cribs filled with sand pumped in; into this sand piles are driven and cut off 2 ft. below low water, and these support a grillage and the stone foundation proper. On the long docks thus formed are built three houses; the one at the dock-end containing the working plant and the other two are for storage. All of the elevators so far built are wood, except the Great Northern Elevator, which is constructed of steel, with square steel tanks. As steel is now costly, the new Peavey elevator may be built of concrete tanks, holding 80,000 bushels each. The Canadian Pacific grain terminals, at Fort William, has a grain elevator capacity of 7,000,000 bushels.

BOOK REVIEWS.

TABLES OF SAFE LOADS FOR WOODEN BEAMS AND COLUMNS.—By Edgar Kidwell and Carleton Moore. Reprinted from the Proceedings of the Association of Railway Superintendents of Bridges and Buildings. Engineering News Publishing Co., New York. Paper; 6 × 9 ins.; pp. 57. 50 cts.

This little book, which is a reprint of a committee report presented at the Richmond, Va., convention of the Association of Railway Superintendents of Bridges and Buildings, contains a series of tables showing safe loads, deflections, etc., for timber beams and columns which were recommended for general use by that committee. The tables cover all the different kinds of timber commonly used in framed structures, and have been carefully prepared and are conveniently arranged for use in making computations.

POTABLE WATER AND METHODS OF DETECTING IMPURITIES.—By M. N. Baker, Ph. B., C. E., Associate Editor "Engineering News;" Editor, "The Manual of American Water-Works." New York: D. Van Nostrand Co. Boards; 4 × 6 ins.; pp. 97; 50 cts.

This book being written by one of the editorial staff of this journal, we follow our general custom of confining our notice to a quotation from the preface, which in this case is devoted chiefly to telling why the book was written and outlining its scope:

> The object of this volume is to present clearly and briefly the essential qualities of potable water, how it may be obtained and the significance of chemical, bacterial and microscopical tests of its quality, both in themselves and relatively. There is also some discussion of the value of pure water, the relations between water and disease, and typhoid fever records as an index of the purity or impurity of public water supplies.
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> The need for some such concise, non-technical review as is here attempted has often been impressed upon the author, and will be evident, on reflection, to all who have had occasion to give attention to the subject. There are to-day some 4,000 cities and villages in the United States and Canada which have a public water supply, while a hundred or more are added to the list each year. A large proportion of these supplies are lacking in one or more of the essentials of potable water, less than two hundred being treated in any manner to make good their deficiencies. Many of the very worst supplies are delivered to our largest cities. An earnest agitation for better water is now in progress throughout the country. It is daily increasing in strength, and already includes hundreds if not thousands of seekers for information that will throw light on their specific local problems. Most of the books on water supply now available are technical in character and relate to the design and construction of water supply and purification plants, to the technique of water analysis, or are devoted principally to statistics showing the effect of the quality of water on the typhoid death rates of cities. These books are most excellent, but many searchers for knowledge wish something less detailed and technical, at least to begin with. Engineers and many water-works superintendents must, of course, plunge deeply into the subject, but hosts of superintendents of smaller works, together with water commissioners, members of boards of public works, health boards, and city councils, mayors, physicians and public-spirited citizens, both men and women, now find themselves for the first time confronted with these important problems of pure water supply and desire to learn something about them without the expense of time or money required by extensive treatises. It is for such people, and for students in technical and medical schools, that this volume is more especially designed. It may shock some people to have it suggested that physicians and members of boards of health are in need of elementary training in matters pertaining to pure water. But such is the case. Until within a few years neither our medical nor engineering schools gave any adequate instruction in sanitary matters, and it is to be feared that some of each class are still deficient in that respect.
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> The author does not expect that those who have paid close attention to all phases of water supply for years past, whether engineers or otherwise, will learn much from this volume. To these, and to all who wish to pursue the matter further, recourse may be had to the following books: Reports of the Massachusetts State Board of Health Since 1889; Hill's "Public Water Supplies;" Hazen's "Filtration of Public Water Supplies;" Kirkwood's "Filtration of River Waters;" Mason's "Water Supply, Chemical and Sanitary," and his "Examination of Water;" Frankland's "Micro-Organisms in Water;" Rafter's "Microscopical Examination of Potable Water;" Whipple's "Microscopy of Drinking Water;" Fuertes' "Water and Public Health;" Fanning's "Water Supply Engineering;" Weston's "Report on Filtration Tests at Providence;" Gould's "Elements of Water Supply Engineering;" Fuller's "Water Purification at Louisville," and also his on the Cincinnati experiments; the Report of the Filtration Commission of Pittsburg, by Hazen, Sedgwick and others; the "Journal of the New England Water-Works Association," and other technical societies; the files of the "Engineering News," "Engineering Record," and other engineering journals.
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> In conclusion, it should be said that this volume replaces one in this series with practically the same title, but otherwise entirely dissimilar, by Charles Watson Folkard and others, published about twenty years ago. The original volume consisted of a paper and discussions before the Institution of Civil Engineers. Nothing could better illustrate the progress of two decades than a comparison of many of the ideas expressed in the earlier volume with the theory and practice of the present day. The present volume has been written without regard to the contents or methods of the earlier one, and is in every respect except name an entirely new book.

MAINTENANCE OF STREET CAR EQUIPMENT.*

In the maintenance of motor equipments to-day, where almost continuous service is demanded and high mileage made, only those equipments fitted with both oil and grease boxes will safely run over 40 days without a thorough overhauling. To overhaul a motor car thoroughly, it is advisable to have at each overhauling shop, extra trucks with motors mounted and all in first-class order ready to run under a car body whose trucks and motors need overhauling. When the body is lifted, the truck to be overhauled is run out and the good truck substituted; car lowered; connected up and turned over to the operating department. The whole operation takes about one hour, and for that length of time only is the use of the car body lost.

For convenience of overhauling, a suitable crane, properly located, equipped with a carriage and another duplex or air hoist, will be found of great convenience. Such a crane can be readily made in any blacksmith shop and for the arm a piece of old rail can be used. When the motor is opened the armature should be lifted out and placed on a suitable rack, where the commutator can be cleaned and the armature tested for insulation. The fields should also be tested for drop. The motor shell should be thoroughly cleaned out, either by compressed air or by washing with kerosene. The grease in the grease-boxes should be taken out and put in the gear case, and the grease-boxes thoroughly washed out with kerosene. Brush holders should be taken out and thoroughly inspected and cleaned. At the same time you have the best opportunity for truck inspection. The writer has found that all overhauling done with car standing over the pits, the bottom half of motor dropped, does not allow the thorough overhauling necessary to keep the motor equipment in the shape it should be kept, besides tying up a complete equipment while such overhauling is being done.

A car started out in perfect order, will safely run five days before it is necessary to inspect it again.

The writer recommends doing as little work as possible at night. At a car-house operating say 100 cars, three men should be able to grease motors, inspect brushes and make any small trolley repairs. Car cleaning should come directly under the operating department. The night car-cleaning should be limited to sweeping out, cleaning windows and dusting cars, while all washing should be done in the day time while the car swings or is on the stand, if the car house is on one end of the line. If the cars are of the closed type, the best way to avoid the collection of dirt and refuse in the sash space, is to make the sash stationary and cover over the space between the top of the seat back and sash rail. This, of course, does away with blinds, and compels the use of curtains. The cost of maintenance is reduced by using curtains.

A car house from which 100 cars are operated should have a good carpenter to make small running repairs and to take care of bell cords and register ringing devices. Any car that has been in a collision and damaged so badly that it could not be repaired in one day should be sent to the general repair shop. All cars should be taken to the general repair shop once a year and the body put in thorough repair and the car varnished or burnt off and painted anew, as the case may demand. While the car is in the carpenter's hands the wiring should be gone over carefully and put in shape. If the car goes to the shop with its regular truck and motors, the truck should be run out and gone over thoroughly. The brake rigging should be taken apart and if the brakebeams work in slots the beams should have what are termed "Dutchmen" clamped into the ends to bring the wearing parts back to their original thickness, as the beams will probably be found to have worn wedge shaped. If the brakebeams are hung by links, these should be renewed where signs of wear show. At this repair shop should be concentrated all classes of repair work, not only repairs to bodies and trucks, but all electrical repairs. The writer believes it pays for all railway companies to make their own repairs to electrical apparatus, including the making of armature coils and renewing of commutators.

In connection with the latter the writer has found that hard-drawn copper makes the best commutator. This is bought in lengths and the bars sawed off with an ordinary metal saw. It will be found that the same bar will often do for several types of commutators. In making commutators yourself it is well to study out the diameter and increase that over those turned out by the factories as much as you can safely get between the brush holders. Drop-forged bars can also be had for any width of commutators you wish.

The writer has found it advisable to make car-body repairs, painting, rewinding armatures, making commutators, armature coils, field spools, etc., by piece work. If good inspection is provided, and the prices are honestly watched, both the company and its employees are gainers by this method. The writer has in mind a case in point. A shop was operated by day work and the regular carpenters' wages were $2.25 per day of 10 hours. Cars that were being remodeled were costing $120. This was changed to piece work and each car given to four men for $110 per car. It was found that the men could do it easily for this and make about $6 over their regular wages. They soon became so expert at this line of work that the price was cut to $80 per car gradually, and the cars are being turned out at this price now, and the men are averagging $2.50 per day. Close inspection, however, is a necessity.

Discussion.

Mr. E. G. Connette (Nashville, Tenn.).—My primary education has been with steam railways, and you all know that when a locomotive has made its trip of 100 to 200 miles, it is taken to the roundhouse to be inspected, cleaned and have all necessary repairs made before it makes its next trip. On my street railway, I adopted a similar method. When a car comes in from its work at night, having run perhaps 100 to 150 miles, it is cleaned and inspected; all the parts of the motor, including the wire connections, the brush contacts, and all the parts of the truck, are properly inspected; loose parts are tightened up and all minor repairs are made to the car, and it is prepared then for its journey on the following day. The general overhauling is done by the regular repair force in daylight, and we make it a rule to have the motors overhauled perhaps once in six months. About two years ago we had a Centennial Exposition, lasting six months. During that period we hauled a very large number of people, and had trail-cars behind every motor car, with a headway of from 1 to 1½ minutes regularly, but during the whole time there were but six motors disabled.

Mr. W. E. Harrington (Camden, N. J.).—On the Camden road we operate about 43 cars, and do the bulk of our inspection and minor repairs at night. We do the general repairs, the carpenter work and painting on the piece-work system, which has proved very satisfactory. One of the difficulties in adopting the piece-work system was in establishing prices for the work, not having any precedent, and we struck upon a method of covering possible mistakes in prices by limiting the amount of bonus that we would give to 20% of the actual cost. If the work cost $2, and the contract price is $5, the actual bonus would be 40 cts.; whereas, if the cost exceeded $5, the loss would not exceed 20% of the actual cost price. That seemed to satisfy the shop men, and enabled us to settle quickly this question; and it has been very satisfactory in its operation. We followed this same practice in our construction work as well as the repair work, and in every respect it has been very satisfactory. We do our car-washing at night, and do that on the piece-work system also. We are washing 18-ft. bodies for 15 cts. a car; sweeping them out, dusting them and washing them thoroughly; and double truck cars for 22 cts. The cost formerly was from 40 to 60 cts. for the same cars. The percentage of cars housed for repairs on our road averages 10% of the total number in operation. We are running single motor equipments and know that our depreciation is relatively high on our armatures and motor parts. I ascribe a great deal of the percentage stated to that fact.

Mr. Van der Veer (Brooklyn, N. Y.).—We find that on some lines the proportion will average 10%, but on others it will go as low as 4%, depending a great deal on the service and the equipment we have at the particular station. I think 10% of the total number of cars is an extreme limit, but it may run even higher than that for single-motor equipments.

Mr. E. C. Foster (Lynn, Mass.).—If 10% of the cars are

*Abstract of a paper presented at the annual convention of the American Street Railway Association, at Chicago, by Mr. J. H. Van der Veer, of the Brooklyn Heights R. R., Brooklyn, N. Y.

in the house all of the time, it seems to me that we should go into the subject further and ascertain if there is any profit in running single-motor cars. Our experience on a suburban and interurban road is that it is not profitable to operate single-motor cars on account of the increased expense incurred in their maintenance, as compared with the double-motor cars. The past season we have been operating each 10-bench open car with two 32-HP. motors. While that is an excessive amount of power, the result so far as repairs have been concerned have been very satisfactory, there being no repairs necessary on that car during the entire summer. We have not even worn out one pair of brushes, though the car has made about 120 miles a day.

Mr. Harrington.—We have been using single-motor equipments, with the exception of a few double-truck cars recently purchased. About a year ago, we equipped one 18-ft. car body with double equipments, and where we averaged a car in the house, say once in every 10 days with the single-motor equipment, the double-motor car has only been in the house three times in a year, and that only for petty repairs. On the strength of the record of that car, we have concluded to order double equipment for 12 of our cars. Our armature depreciation has been tremendous and altogether out of reason. On a 40-car road we have one man busy all the time doing nothing else but looking after the armatures, and I think we will be able to put him on some other work as well when we have more of these double equipments.

Mr. Connette.—There is a saving in power in running single-motors. In Nashville, Tenn., there is very little level track. I tested a single-motor car, and found that it used about 35% less power than a car with two motors, but we could not use the single-motor for lack of traction. Most of our roads have no loops at the end, and consequently the ends of the car are reversed and when the motor was in front there were many places where it was quite difficult to get up a grade with a single motor when the motor was on the front axle. In Louisville, Ky., nearly all the cars are run with one motor only. Their cars are small, most of them having been old horse-cars, and as the city is comparatively level, I understand they operate very satisfactorily.

Mr. Douglass (Cleveland, O.).—This question of single and double-motor cars depends a good deal on the condition of the track. The "Big Consolidated" road of Cleveland has some bad track with old Johnson rails on chairs, and we have recently purchased 150 double-truck cars, partly because they will run smoothly over the track, which the single-truck cars will not do. Single-truck cars, 18 to 24-ft. in length, can be operated more easily and simply than double-truck cars, and we should not discard them if our track was in good condition.

Mr. J. I. Beggs (Milwaukee, Wis.).—I do not believe that any road can judiciously run single-motor cars. The 35% of power saved, which has been referred to here, is threefold paid for in greater cost of repairs to single motors and other portions of the car. I think the cheapest thing virtually that we put on an electric railroad is the power that moves the car; it costs less than almost anything else going onto the car. About 3½ years ago we adopted as standard a double-truck car. We are now introducing cars on which we put four motors, a motor on each axle. The traction is much better, and we can speed up a car more quickly, and when you take a city where you stop every block or every 200 or 300 ft., it is an important item if you can save a few seconds in making these stops, and in getting the cars in motion, and thereby better accommodate the public and reduce the number of cars necessary to make a schedule on any given line. We find that it costs less for the maintenance of a car with four motors than for a car with two motors. The actual cost of maintaining the equipment under the car is reduced, and the number of cars in the shop averages only 2%. We have several grades, none very severe, but we have no trouble from slippery rails or frost in winter with the four-motor equipment. The number of flat wheels is greatly reduced, and in every way the cost of maintenance on a four-motor equipment is 25% less than on a two-motor equipment. I believe there is much greater proportionate saving between the two-motor equipment and the single-motor equipment.

Mr. Connette.—On small cars, where the streets are comparatively level and where the power of the motor is in proportion to the size of the car, I think a single-motor can be operated for less expense than a double-motor equipment. I know by actual meter tests that for an 18-ft. closed car body, single-truck, double-motors, it requires about 150-K-W. hours per day, for 125 to 140 miles run. The cost of power, of course, varies; but a fair average is 1 ct. per K-W. hour. Therefore, if you use 150-K-W. hours per day for each car, and you save 33⅓% the saving of power would be 50 cts. per car per day, and where 30 cars are run it means a saving of $15 a day for power. It strikes me, from the experience I have had in maintenance, that it will not cost as much to maintain one motor, even with a little extra service, as it does to maintain two motors. But when the element of service enters into the question in large cities, where you have larger cars and higher speeds and heavier travel, then you can get more effective and satisfactory service with two motors on a car.

Mr. Beggs.—We do not use power brakes on our city equipments. We have some cars equipped with air brakes, but shut them off in the local service. We try to maintain a speed of 8½ miles over the whole system, even on lines where we stop every 300 or 400 ft. There is none of the equipment which makes less than 160 to 170 miles daily to a car. On our interurban lines we make as high as 380 miles a day to a car, day in and day out. On our high-speed interurban lines, we have maintained the service for 18 months, with two cars, making 19 trips a day of 20 miles each. On these lines we have air brakes and electric head lights, which are absolutely indispensable to a high-speed interurban line. On certain portions we reach a speed of nearly 50 miles an hour. This line runs between Milwaukee and Waukesha, and we have six or seven miles in the city limits where we run the cars in local service. The cars become part of the local service when they enter the city limits. The speed on that line is anywhere from 30 to 50 miles an hour. This line is on private right of way. We have one interurban line, 35 miles in length, on a public highway. We do not get such high speed on that line, but hope to reconstruct it so as to be able to do so.

Mr. Lang (Toledo, O.)—We are operating a street railway and an electric light plant combined, and we maintain a brass foundry, paying our foundryman $1.75 a day. He spends his entire time in the brass foundry and he takes all the scrap brass we have and works it into every available place where brass is used on the bar, in the lighting plant, and about the power house. We are satisfied that this a most economical plan. We have just begun splicing two 16-ft. car bodies together, utilizing four-wheel cars that have been in operation from eight to ten years. We have put them on double trucks, and have placed these cars upon one of our longest lines, where we have been maintaining a nine-minute headway for some two or three years, and found a necessity for shortening the interval. We think we are still going to maintain our nine-minute headway without complaint, because they take more passengers and their speed is as good as a 16-ft. car. It was argued that we would not be able to maintain our speed, using two 25-HP. motors, but as we have few grades, we can maintain our speed just the same. It costs about $300 to splice cars in this way.

Mr. Dimock (Council Bluffs, Ia.).—We took 16-ft. car bodies that had been in service for between six and seven years, spliced them together and made a 42-ft. car over all, including vestibules. We have run these cars for five years, and outside of the painting we have had no repairs to speak of since the day they were rebuilt. The splicing of these cars costs us $300 to $400. We find that the double-truck car is better for the service. It was claimed that we could not keep up our schedule on the same headway, after splicing these cars; and especially so after putting gates on them. We equipped these cars with gates which are operated with a lever controlled by the motorman, and we find that the power consumed is somewhat greater than it was before the gates were put on, on account of the additional number of dead stops required to be made. Nevertheless the car is giving better service, and running on the same time card as the 16-ft. car. The speed in many places is as high as 30 miles an hour, and the repairs are not more than on the 16-ft. car.

Mr. Beggs.—We have determined that it is not economical to splice our old car bodies, for the reason that by the time you have these trucks under the car, the cost of the car—while still an old car—is fully half the cost of the best car that can be built, and after spending this money in splicing these cars you still have an old car.

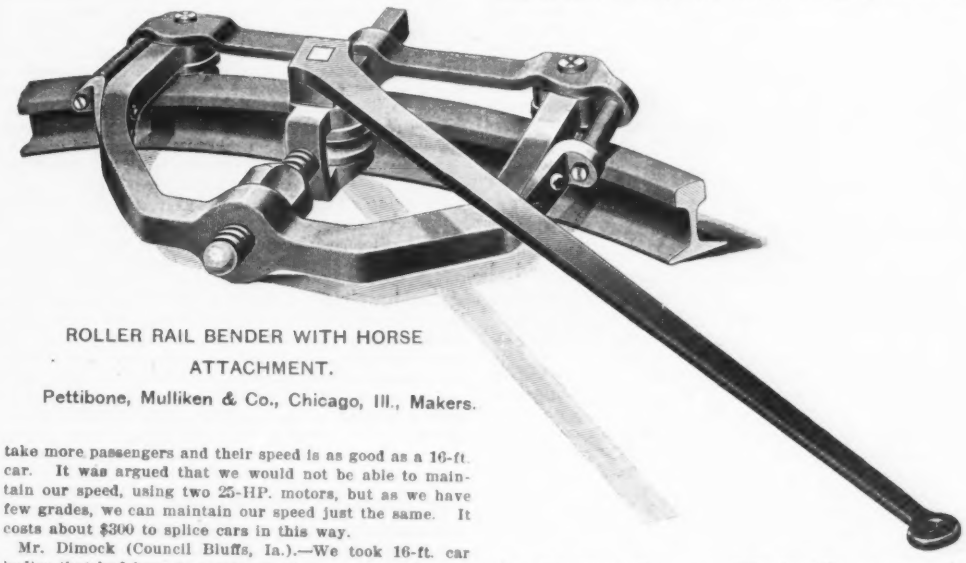
Mr. Dimmock.—We have run our cars five years without repairs, but in order to make our car as good as we thought it ought to be, we had a steel frame put around the bottom of it, with truss rods, which has enabled the car to stand all the strains of bad track, etc. I will admit one point, however, that if we were buying new cars we would prefer to make them lighter and use cross seats. We also spliced our 16-ft. open cars. Our track centers will not permit a wide car, and this fact influenced our decision to splice the old cars.

Mr. Beggs.—As to the mileage of trolley wheels, we get about 8,000 or 9,000 miles from our wheels. I know of roads that get as high as 17,000 miles. Our policy, however, is to wear the wheel instead of the wire. Our wheel is made up of a composition of 86% copper, 8 or 9% of tin, and 4 or 5% of zinc. It costs less to wear the wheel than the trolley wire. The cost of putting up the wire is as great as the wire itself. Certain roads make a boast of the number of miles they get out of a trolley wheel. They used a steel wheel in Milwaukee three years ago and were wearing out the wire very rapidly.

A RAIL BENDER OPERATED BY HORSE POWER.

Roller rail benders are extensively used in railway tracklaying and maintenance of way, to bend rails for curves and to straighten bent rails. With the heavy rails now being so generally used, however, the operation of the machine by hand is slow and hard work, even with the long levers on the socket wrench used to turn the middle, or driving roller. In order to provide for this difficulty, the firm of Pettibone, Mulliken & Co., of Chicago, is fitting some of its roller rail-benders with a horizontal bar or sweep (instead of the vertical T-handled socket wrench), to which bar a horse can be attached. This is shown in the accompanying cut.

The machine consists of a heavy yoke, having at each end a vertical roller to bear against the outer side of the rail, and a horizontal roller to rest on top of the rail. At the middle of the yoke is a third roller, carried in a sliding frame, and set at any required distance from the line of the other rollers by means of a screw and nut. In operation, the machine is set on the rail and the middle roller is adjusted to the necessary ordinate for the required curve. The handle or sweep is then fitted on the square shaft of the middle roller, and is steadily revolved, the machine traveling along the rail and bending it to a uniform curve as it goes. In many respects this machine is superior to the lever rail-bending machines, which are operated at various points along the rail and not continuously throughout its entire length. For straightening rails, the machine is set with the middle or driving roller on the outside of the curve.



ROLLER RAIL BENDER WITH HORSE ATTACHMENT.

Pettibone, Mulliken & Co., Chicago, Ill., Makers.

THE ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

The 27th annual convention of the American Gas Light Association was held in New York city Oct. 18 to 20, 1899. The authors of most of the papers read confined themselves closely to matters of interest to gas manufacturers alone, but some points of more general interest were brought out.

In the address of President A. C. Humphreys, the increasing use of water gas was touched upon. For the enrichment of this gas, there are now used 220,000,000 gallons of oil annually. The price of oil is going up, but recent improvements make it possible to use crude oil. It was suggested that gas manufacturers might combine to control their own oil fields. The proper proportions of water gas and coal gas to be used must be determined by commercial considerations in each instance. It will perhaps be economical for some to return entirely to the manufacture of coal gas. This will depend upon whether a market can be found for the coke and ammonia produced.

It was stated that at Boston, where coal gas is made on a large scale, the coke is taken by the railroads for use in locomotives. Cheap ammonia would find a wide use in agriculture.

A paper on "Prepayment Meters," was read by A. H. Strecker, of Newark, N. J. Meters of this type have been used in Newark, but not with entire success, commercially. In the discussion following, some of the speakers said they had reached a similar conclusion in regard to prepayment meters, while others stated that their use had been very satisfactory.

In the next paper, "Pumping Gas," was discussed by Mr. Geo. J. Roberts, of Philadelphia, Pa. The paper deals chiefly with the difference in efficiency of the fan exhauster and the positive exhauster, the results of the author's investigations showing in favor of the latter type.

The third paper was entitled, "Another View of Interior Illumination," and was presented by Mr. F. N. Morton, of Hoboken, N. J. The subject discussed was that of the best distribution of light for the comfort of the eyes. The conclusion was reached that the light should be considerable in quantity and emitted from a large area, in order to secure diffusion. This opinion was concurred in by Dr. Harry Morton, of Boston.

"Some Experiments with the Edgerton Standard" was the title of a paper read by Mr. Rollin Norris, of Philadelphia, Pa. As the results of many comparisons with a pentane lamp, the Edgerton standard was declared to be very unreliable as now used. The author advocated the use of the pentane lamp and exhibited a lamp of this type embodying several improvements.

Mr. Allen S. Miller, of New York city, presented a paper on "Steam Consumption in a Water Gas Plant." The great inefficiency of small auxiliary steam apparatus was pointed out and the substitution of electric motors therefor, was advised. This suggestion, however, did not meet with favor from some of the members, one of whom said it would be "a case of the devil in the camp of the Lord."

The last paper read was on the subject, "Carburetted Water Gas as a Coal Gas Auxiliary," by Mr. A. G. Glasgow, of London. It was pointed out that a water gas plant was often a profitable addition to a coal gas plant, even if the cost of water gas per M. was greater than that of coal gas, for the reason that water gas producers can be brought into action at short notice, and may be used to take care of variations of consumption. In the case of coal gas, on the other hand, it takes some time to heat the retorts and they cannot be profitably operated for short intervals, and the surplus plant is more expensive to maintain than with water gas.

ANNUAL CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION.

The 18th annual convention was held in Chicago, Oct. 17 to 20, the headquarters being at the Auditorium Hotel, and the meetings and exhibits being at Tattersall's Hall. On Oct. 17, the meeting was called to order at 11:20 a. m. by the President, Mr. Charles S. Sergeant (Boston Elevated Ry.), and a brief address of welcome on behalf of the Mayor was made by Mr. H. S. Taylor, Public Prosecutor. The President then read his address, in which he referred to the last meeting of the association at Chicago, in 1883, when the street railways had 153 miles of single track, while at the present time the city, suburban and elevated railways have 1,097 miles of track. He also made a few remarks as to public ownership, from a street railway company's point of view, implying that the advocates of this system are of necessity in the wrong.

The report of the Executive Committee was then read by the Secretary, Mr. T. C. Penington (Chicago City Ry.), who then presented his own report as Secretary and Treasurer. This showed receipts of $7,651, and expenditures of $5,648, with a balance of $5,659 in the bank on Oct. 11. The membership includes 172 companies.

This ended the routine proceedings, and Mr. Chas. T. Yerkes (Chicago), then read a paper on street railways as investments, an abstract of which is given below:

How Can Street Railway Investments be Made Secure and Remunerative.

In the early days, the street railways in each city were owned by a few individual persons, and the stocks and securities of the companies were but little distributed. Few people knew of their value or cared to have much to do with them, and it was not until after 1870 that the banks would look at the stock as collateral. Abaut 1880, when consolidation began, and the consideration of the question of how best to operate the roads was more in fashion, the attention of capitalists and people generally was drawn to these securities, and since then their popularity as investments has continued to increase.

The security of the investment is of prime importance, the remuneration must be brought about by hard work. The control of the expenditures is the science of street railway management. The most important matter in regard to security is the length of time covered by the charter. The longer the time, the greater are the improvements, and the more expensive is the plant that can be operated. In Illinois, 100 years is the time granted by the state for a street railway charter, while the municipality grants an ordinance for 20 years. This may have been right for early horse railways, with light track, cheap cars, horses and a 5-acre lot in the suburbbs for car barns. But on this basis, with the expensive track construction, power plant, cars and outdoor equipment of modern electric railways, these railways should have charters and ordinances for 200 years.

A fair amount of the earnings of the companies should be given to the municipalities in which they are located, for while the railways are of great benefit to the municipalities and the people, yet it is through the former that the companies are permitted to transact their business. The extension of lines in a large city is a great burden upon the cimpany. There is little money to be made for some years, and while the company is waiting, the property owners and the people are benefited. The people should be educated to understand these conditions. Every state having large cities should have a commission appointed to ascertain the conditions and requirements of the street railway interest, to see that the laws are carried out and that the companies have the protection to which the law entitled them. To make securities more secure, all these matters must be fully understood: (1) Business must be done in a straightforward manner, with due consideration to the public; (2) increased facilities and improved transportation must be provided as opportunity offers or circumstances require; (3) there must be perfect harmony between the employees and the management; (4) the companies must be able to honestly earn a fair remuneration for the money, time, expenses and labor expended.

Mr. C. D. Wyman (New Orleans), referred to the growing favor with which street railways are regarded by investors, and thought the companies should see to it that their managers and directors are men of such ability and reputation as to make the public feel confidence in the enterprises. He advocated greater publicity as to the affairs of the companies, by means of published circulars, statements, etc., distributed to the investors. A uniform and simple method of bookkeeping should be adopted, for which reason he heartily approved the work of the Street Railway Accountants' Association. Some railways are taking into account the question of depreciation and renewal of the plant, the equipment, and the different mechanical parts entering into the physical equipment, and are setting aside annually a certain sum from the receipts to provide for the depreciation. Mr. John I. Beggs (Milwaukee El. Ry. & Light Co.), stated that his company is making systematic provision for the replacement, possibly at the same time, of the roadbed, the equipment, the car stations and the power plants. He thought this should be done before the public can expect reduced rates or similar concessions. Provision should also be made by means of a sinking fund to meet the bonds when they mature.

Mr. H. H. Vreeland (Metropolitan St. Ry. Co., New York), considered that the accounting should be more in accordance with practice on steam railways, where it is not only shown that tonnage and mileage have increased, but in what classes of service there has been increase or decrease, and where the financial results of operation are carefully analyzed. Mr. E. C. Foster (Lynn), explained that in Massachusetts, the Board of Railroad Commissioners has supervision over street railways, and the franchises granted are without limitation. The board not only protects the investors, but also protects the companies from unreasonable action on the part of local authorities, since the companies have the right of appeal to the board. On the other hand, the board has power to revoke the licenses, but only when it can be clearly shown that the removal of the line is a public necessity. Mr. N. H. Heft (N. Y., N. H. & H. R. R.) showed that in order to make street railways good investments, careful attention must be paid to operating economies. He recently found that with modern equipment the deal load amounted to 721 lbs. per passenger, which is only 137 lbs. less than with steam railway equipment. As a result of this investigation, he expects to introduce cars weighing only 227 lbs. per passenger.

The meeting then adjourned. In the evening there was a reception at the Auditorium Hotel.

On Oct. 18 the meeting was called to order soon after 10 a. m., and Mr. J. H. Van der Veer (Brooklyn Heights R. R.) presented a paper on "Maintenance of Car Equipment," an abstract of which is given in another column, together with some notes from the discussion.

In the afternoon a special train, provided by the Atchison, Topeka & Santa Fe Ry., carried a party of nearly 500 members and guests to visit the Chicago Drainage Canal. Stops were made at different points, and the controlling works at Lockport were also inspected. The evening was "ladies' night," at the exhibition hall.

On Oct. 19, the meeting was called to order about 10:30 a. m. The first paper was on "The Construction and Maintenance of Street Railway Track," by Mr. Edward Betts, of the Metropolitan St. Ry. Co., Kansas City, Mo. An abstract of this paper, and of the discussion which followed, will be found in another column.

The Nominating Committee then presented its report, and the officers for the coming year were elected as follows: President, John M. Roach, General Manager of the Chicago Union Traction Co.; First Vice-President, John A. Rigg, President of the Union Traction Co., Reading, Pa.; Second Vice-President, H. H. Vreeland, President of the Metropolitan Street Ry. Co., New York city; Third Vice-President, F. C. Jones, Vice-President of the Memphis Street Ry. Co.; Secretary and Treasurer, T. C. Penington, Treasurer of the Chicago City Ry. Co.; Executive Committee—The President and Vice-Presidents, C. S. Sergeant, Second Vice-President of the Boston Elevated Ry. Co.; C. K. Durbin, General Superintendent of the Denver Consolidated Tramway Co.; Nicholas S. Hill, Jr., General Manager of the Charleston Consolidated St. Ry. & Electric Co., Charleston, S. C.; Charles W. Wason, President of the Cleveland, Painesville & Eastern Ry. Co., Cleveland, O.; and John R. Graham, President of the Quincy & Boston St. Ry. Co., Quincy, Mass.

Invitations from three cities were then presented, and Kansas City, Mo., was selected by vote as the place for holding the convention in 1900.

The fourth and last paper was then presented on "Train Service and Its Practical Application," by Mr. Ira A. McCormack, Superintendent of the Brooklyn Heights R.R., Brooklyn, N. Y.

The paper described methods of recording traffic on street railway lines and adjusting the car service so as to best accommodate the travel with a minimum expense to the company. The paper was discussed by Messrs. Holmes of Kansas City, and Vreeland of New York. This concluded the technical work of the convention.

In the afternoon there were excursions to Jackson Park and to the stock yards, but the exhibition hall was well attended in the afternoon, owing to the weather being unfavorable for excursions. In the evening there was a theatre party.

Oct. 20 had been set aside for the express purpose of inspecting the exhibits, which were very numerous and comprehensive. A general list of these exhibits will be found in our Supplement. In the evening the annual banquet was held, at which the new officers were installed.

The street railway companies of Chicago united in presenting the "freedom of the city" to those in attendance at the convention in a very practical and pleasant manner. Every member and visitor was presented with a buttonhole badge which served as a free pass on any line during the four days of the convention.

WEATHER TABLE FOR SEPTEMBER, 1899. (Furnished to Engineering News by the Department of Agriculture.)

	Stations.	Temperature. (Degrees Fahrenheit.)				Wind.			Precipitation—Rain or melted snow. (Inches.)		
						Velocity in miles per hour.		Direction at time of max. velocity.			
		Average.	Max.	Min.	Range.	Average.	Max.		Total.	Heaviest in 24 hours.	No. of rainy days.
Northern Cities.	Northfield, Vt.	54.3	80	26	54	9.6	38	N	4.19	1.68	13
	Portland, Me.	57.6	75	40	35	7.7	28	NE	4.47	1.88	11
	New York City	65 2	84	46	38	13.6	64	E	5.89	2.43	10
	Pittsburg, Pa.	65.4	92	39	53	6 0	23	S	2.66	1.02	11
	Chicago, Ill.	62.7	98	32	66	16.4	47	W	2.39	0.66	10
	Omaha, Neb.	66.4	99	33	66	8.1	40	N	0.53	0.32	2
	St. Paul, Minn.	59.0	88	28	60	7.9	38	NW	1.21	0.43	11
	Duluth, Minn.	55 1	79	29	50	9.2	36	NW	2.05	1.46	10
	Bismarck, N. Dak.	57.8	95	25	70	10.1	51	NW	0.06	0.04	2
	Average	60.4	88	33	55	9.8	41	—	2.61	1.10	9
Southern Cities.	Washington, D. C.	65.8	94	41	53	5.8	34	NW	6.14	2.71	10
	Louisville, Ky.	69.8	102	36	66	6.0	37	NW	0.59	0.46	5
	St. Louis, Mo.	70.1	102	37	65	9.6	32	W	1.27	0.84	5
	Savannah, Ga	76.4	94	53	41	6.7	24	E	4.22	3.82	4
	Kansas City, Mo.	68.2	99	35	64	8 0	32	NW	1.66	0 69	3
	Jacksonville, Fla.	77.4	93	54	39	6.6	24	NE	5.10	2.71	8
	Chattanooga, Tenn.	70.8	97	41	56	5.7	26	NW	1 42	0.62	5
	New Orleans, La.	77.7	95	57	38	8.1	31	N	0.35	0.20	5
	Memphis, Tenn.	72.6	96	39	57	4.7	28	NE	0.52	0 24	3
	Palestine, Tex.	76 2	98	43	55	5.3	19	NE	0.28	0.28	2
	Average	72.5	97	44	53	6.6	29	—	2.18	1.26	5
Western Cities.	Helena, Mont.	—	—	—	—	—	—	—	—	—	—
	Port Crescent, Wash.	56.2	82	39	43	4.0	18	W	0.79	0.47	7
	San Francisco, Cal.	58.2	73	48	25	12.6	40	W	0	0	0
	Salt Lake City, Utah.	67.1	91	46	45	5.2	28	NW	T	T	0
	Santa Fe, N. Mex.	63.2	86	37	49	5.5	25	SE	1.39	0.70	6
	Denver, Colo.	65.0	97	35	62	7.2	43	W	0.20	0.20	1
	Yuma, Ariz	—	—	—	—	—	—	—	—	—	—
	Average	61.9	86	41	45	6.9	31	—	0.48	0.27	3

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